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ABSTRACT

These resource materials, developed for use by teachers in the elementary and secondary schools, are designed to provide the teacher with a bibliography, questions and answeres, and suggested classroom activities all relating to the energy problem. The materials are designed to develop a conservation ethic and greater understanding of our energy problem. The publication is divided into three parts. Part I, Energy in the Natural Environment, consists of a representative bibliography of sources concerning energy. Included are a subject index, an alphabetical listing of books and periodicals by title, a listing of audiovisual materials, and the addresses of the publishers of the bibliographical entries. Part II, Energy in the Social Environment: A Guide to Resource Material, contains instructional materials designed to assist classroom teachers in developing and enriching an energy awareness unit or lesson. Part III, Possible Classroom Activities, contains an elementary, intermediate, and secondary unit on energy. Additional resources include an energy simulation game, the Iowa Geological Survey Materials, and a listing of environmentally related organizations and their addresses. A glossary of terms concludes this publication. (BT)

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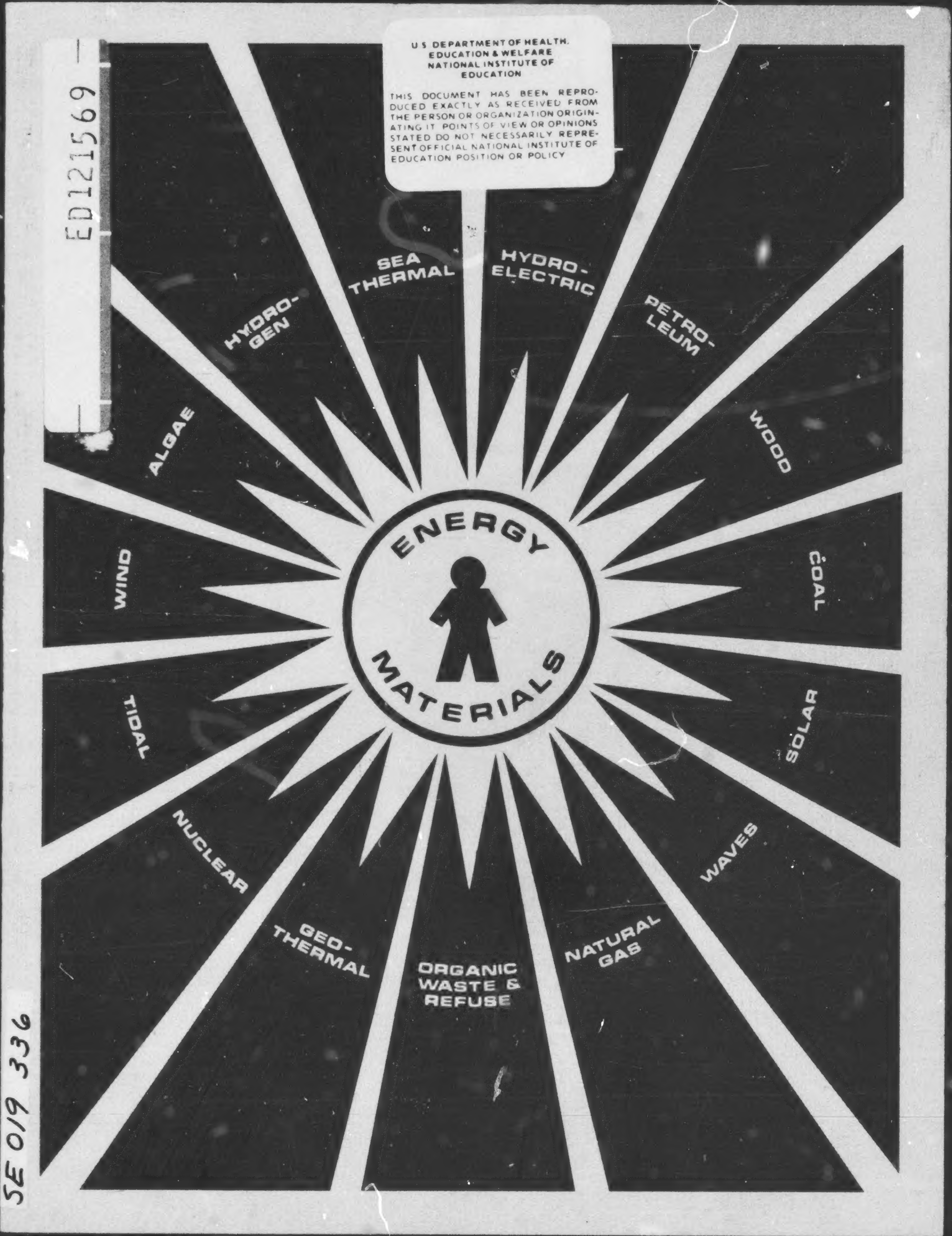
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PREFACE

Energy Awareness Week in December of 1973 served as a prelude for many schools in Iowa to deal with the energy problem. The enthusiastic response by many schools during the awareness week and the period that followed was most rewarding. It was suggested at that time that additional information would become available from the Department of Public Instruction. In response to that pledge each elementary and secondary school in Iowa will be provided this resource material.

The initial thrust of Energy Awareness Week was to provide the teacher with a bibliography, questions and answers, and suggested classroom activities all relating to the energy problem. The energy problem will be with us for several years. These materials are intended to help the teacher with his or her instruction to help students develop a conservation ethic and greater understanding of our energy problem.

INTRODUCTION

The natural and social implications of usage and conservation of energy are concerns of society which must be dealt with in our classrooms. The information contained in this set of materials deals with the primary sources of energy, conservation of energy, energy in the social environment, and suggested classroom activities. It is hoped that the students using the suggested activities and resources will sharpen thinking and research skills so that they may arrive at feasible solutions and/or alternatives associated with the energy problem.

On Wednesday evening, November 7, 1973, President Nixon in a nationally televised speech, outlined a plan of action for overcoming both short-term and long-term energy shortages which included methods of energy conservation. In addition to the President's statement the Honorable Robert D. Ray, Governor of the State of Iowa, proclaimed an Energy Awareness Week, December 10-15, 1973. It was recommended that each school conscientiously carry out an educational program involving study, demonstrations, experiences and discussions of the importance of conserving energy.

Through immediate and long-range planning it is hoped that we as educators can achieve substantial improvements in students' awareness, students' understanding, and students' conceptualization of knowledge regarding conservation and usage of our energy resources. Utilization of the following suggested materials and activities as well as other resources should assist the educators in achieving this task.

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PART I

ENERGY IN THE NATURAL ENVIRONMENT

PART I

ENERGY IN THE NATURAL ENVIRONMENT

PART I consists of a representative bibliography (not intended to be exhaustive) of sources concerning energy. Help in locating these resources may come from your local school or public library, college or university library or regional media centers.

Fifteen prime energy sources are identified. These are used in Section One which serves as a subject index to the bibliographic entries. A general category is added for material too broad in coverage to be assigned to a specific subject. Each major subject or energy source is further subdivided by the basic related concerns: (1) availability of energy, (2) usage of energy and (3) conservation of energy. The number of each pertinent bibliographic entry is given under prime energy source and/or subheading.

Section Two contains an alphabetical listing of books and periodicals by title which has been numbered for reference purposes for this set of materials.

In Section Three is found an alphabetical listing of audiovisual materials by title which have been numbered with "A/V" notation for reference purposes.

Section Four provides the user with complete addresses of the publishers of the bibliographical entries listed in Sections Two and Three.

Section One: A quick reference system for locating information on energy.

Example:

Information concerning one of fifteen prime energy sources and "general" information can be found by following the steps listed in the example given.

STEP I. Locate the desired main heading from Section One, such as COAL.

STEP II. Select appropriate heading or subheading such as "Availability."

STEP III. Note that under COAL - Availability, eight entries from Section Two--books and periodicals are cited: Nos. 14, 19, 25, 28, 48, 72, 95, 135; two entries from Section Three--audiovisual materials are cited: Nos. 6A/V, 22A/V.

STEP IV. Turn to the appropriate entries in Sections Two and Three for complete entry and annotation.

STEP V. Turn to Section Four for addresses if needed.

Section One

1. WOOD

Availability -- 66, 69, 91, 95, 16A/V
Usage --------- 91
Conservation -- 63, 71, 74, 91, 31A/V

2. COAL

Availability -- 14, 19, 25, 28, 48, 72, 95, 135, 6A/V, 22A/V
Usage --------- 17, 18, 115, 132, 26A/V, 28A/V
Conservation -- 23

3. PETROLEUM

Availability -- 11, 12, 13, 16, 25, 27, 43, 48, 65, 73, 88, 95, 107, 112, 124, 125, 127, 130, 135
Usage --------- 6, 13, 29, 67, 73, 103, 111, 131, 132, 136, 26A/V, 28 A/V
Conservation -- 5, 62, 76, 79, 90, 93, 117

4. NATURAL GAS

Availability -- 25, 88, 95, 105, 124, 135
Usage --------- 132, 28A/V
Conservation -- 77

5. NUCLEAR

Availability -- 3, 9, 10, 25, 48, 78, 83, 86, 95, 99, 100, 109, 118, 135, 1A/V, 2A/V
Usage --------- 100, 120, 28A/V
Conservation -- 13A/V

6. ORGANIC WASTE AND REFUSE

Availability -- 24, 54, 55, 97, 104, 110
Conservation -- 4, 44, 113, 17A/V

7. SEA GRADIENT (SEA THERMAL)

Availability -- 101, 116

8. HYDROELECTRIC

Availability -- 80, 102, 122, 135
Usage --------- 119, 123, 27A/V, 32A/V

9. TIDAL

Availability -- 30, 36, 64, 80, 85, 89, 101, 24A/V, 28A/V, 30A/V

10. WAVES

Availability -- 36, 64, 89, 128, 25A/V, 28A/V

11. WIND

Availability -- 135, 15A/V, 33A/V
Usage --------- 122, 132
Conservation -- 4A/V

12. ALGAE --------- 7, 8, 108, 134

13. GEOTHERMAL

Availability -- 80, 84, 89, 102, 124, 129, 135, 5A/V, 18A/V, 21A/V

14. SOLAR

Availability -- 20, 60, 61, 80, 94, 96, 122, 124, 135
Usage --------- 132, 9A/V, 19A/V, 28A/V

15. HYDROGEN

Availability -- 82, 135
Usage --------- 26, 34, 35, 68, 133

16. GENERAL ------- 1, 2, 15, 31, 37, 38, 39, 40, 41, 42, 47, 48, 53, 58, 64, 81, 114, 121, 124, 126, 20A/V

Availability -- 25, 36, 50, 80, 88, 95, 102, 135, 12A/V, 29A/V
Usage --------- 21, 32, 33, 51, 52, 57, 59, 87, 122, 132, 10A/V, 11A/V, 14A/V, 26A/V, 28A/V
Conservation -- 21, 22, 45, 46, 49, 52, 56, 70, 75, 92, 98, 106, 3A/V, 7A/V, 8A/V, 23A/V

Section Two: A selected bibliography of books and periodicals.

1. The AAAS Science Book List. By the American Association for the Advancement of Science, 3rd edition. 1970. Compiled by Hilary J. Deason.
   A selected and annotated list of science and mathematics books for secondary school students, college undergraduates and non-specialists.

2. The AAAS Science Book List for Children. By the American Association for the Advancement of Science, 3rd edition. 1972. Compiled by Hilary J. Deason.

3. "AEC Expects Fusion-Power Demonstration by Mid 1990's." By G. B. Lubrin. Physics Today. Vol. 26:77-79. October, 1973.

4. About Garbage and Stuff. By Ann Zane Shanks. Viking Press. 1973. $5.95. K-6.

5. "The Age of Guzzle Brings the Era of Sip." By Richard Egan. The National Observer. pp. 1, 19. November 24, 1973.

6. "Ag's Share of Energy Is Small." Farmland News. January 31, 1974.
   Usage of petroleum products by agriculture.

7. Algae. By Harold E. Schlichting, Jr. and Mary Southworth Schlichting. Steck. 48pp. 1971. $2.95. Elementary.
   Discusses fully the small specimens of algae and emphasizes the ecological importance of these organisms.

8. "Algae as Pollution Indicators: Analysis Using the Membrane Filter." By B. I. Sohn. American Biology Teacher. Vol. 34:19-22. January, 1972. Secondary.

9. Atomic Energy. By Irving Adler. John Day Co. 47pp. 1971. $3.69. Grades 4-6.
   Explains why atomic energy may be the only answer to fuel for power in the future.

10. Atoms, Energy and Machines. By Jack McCormick. Creative Educational Society. 224pp. 1967. $6.95. Grades 4-6.

11. "Big Iron Moves to the North Sea." By J. F. Pearson. Popular Mechanics. Vol. 140:128-133. October, 1973.
    Oil well drilling - submarine.

12. "Big Oil--Under Pressure." Newsweek. pp. 79-80. December 17, 1973.

13. "Blame Oil Firms in '72 Pinch." By George Anthan. Des Moines Register. pp. 1, 11. November 30, 1973.

14. "Capturing Clean Gas and Oil from Coal: To Fully Exploit Its Major Energy Reserve, The U. S. Needs a Crash Engineering Job Comparable to Building the Atomic Bomb." By Lawrence Lessing. Fortune. Vol. 88:128-31. November, 1973.
    Coal gasification, coal liquefaction.

15. "The Causes of Pollution." By Barry Commoner, Michael Corr, and Paul J. Stawler. Environment. Vol. 13. April, 1971. Secondary.
    This article states that the equation of population size x per capita consumption x environmental impact per unit of production = level of pollution. It shows that modern technology is the primary contributor.

16. "Chides Europe for Yielding to Arabs on Oil Boycott." By Joseph Kraft. Des Moines Register. p. 6. November 20, 1973.

17. "Cleaning Up Coal Smoke; Reducing Sulphur Dioxide Emissions." Time. Vol. 102:136. November 12, 1973.
    Coal research.

18. Coal. By Irving and Ruth Adler. John Day Co. 47pp. 1965. $3.96. Grades 3-6.
    Traces the development of coal, how it is mined, its uses and its many by-products.

19. Coal Mining in Iowa. By Hubert L. Olin. State Mining Board, Iowa Department of Soil Conservation.
    History of coal mining in Iowa.

20. The Coming Age of Solar Energy. By D. S. Halacy, Jr. Revised edition. Harper. 241pp. 1973. $7.95. Junior High.
    A good survey of the many methods of utilizing solar energy. The reader will be amazed at the variety of schemes proposed to capture the energy of the sun.

21. "Conservation of Energy: The Potential for More Efficient Use." By Allen L. Hammond. Science. Vol. 178:1079-81. December 8, 1972. Grades 7-12.
    The article deals with the potential for reducing the demand for energy by means of more efficient use of energy resources. The savings seem to be enormous, that is, as much as 25 percent.

22. "Conservation and the Schools." By W. K. Beal. Trends in Education. pp. 27-32. January, 1973. K-12.
    This article discusses the ways in which environmental studies are being introduced into primary and secondary schools.

23. "Controlling the Strippers." Time. pp. 96-97. October 22, 1973.
    Coal mining.

24. Conversion of Municipal Refuse, Sewage Sludge and Other Wastes to Heavy Oil or Bitumen. By Herbert R. Appell and John S. Tosh. Department of the Interior. Report Number: PB-220 992/2. $ .50.
Government-owned invention available for licensing. Copy of patent available from Commissioner of Patents, Washington, D. C. The invention relates to the conversion of solid municipal wastes and other wastes to heavy oil or bitumen. Municipal sewage sludge, refuse and other wastes are converted to heavy oil or bitumen by heating under pressure, in the absence of air, in the presence of carbon monoxide and water.

25. "The Cross - Elasticity of Demand and Industry Boundaries." By David Schwartzman. Antitrust Bulletin. No. 18:483-507. 1973.
Coal, oil, gas and uranium.

26. Design of a Miniature Hydrogen Fueled Gas Turbine Engine. By M. Buriett, R. C. Lopiccolo, M. R. Simonson, G. K. Serovy, and T. H. Okiishi. Cincinnati University. 262pp. February 2, 1973. Report No.: NASA-CR-112173; Contract: NASI-9752. NTIS Prices: PC/$15.25; MF/$1.45.
The design, development, and delivery of a miniature hydrogen-fueled gas turbine engine are discussed.

27. "Dimouts, Slowdowns, Chills." Time. pp. 89-95. November 19, 1973.
Imports of oil by the U. S. contrasted with U. S. productions. Discussion on untapped deposits (oil) in U. S. Coal and nuclear power mentioned.

28. "Dirty Black Ace in the Hole." Newsweek. pp. 93-94. November 12, 1973.

29. "Dryer Fuel and Storage: How Scarce?" By G. Reynolds. Farm Journal. Vol. 97:17. August, 1973.
Liquefied petroleum gas.

30. Ebb and Flow: The Tides of Earth, Air and Water. By Albert Defant. University of Michigan. 1958. Paper $2.25. Grade 10 and up.
The tides--what they are, how they operate, and how they are caused--are explained in this story of the forces that move our world.

31. Education That Cannot Wait. U. S. Government Printing Office. 1971.
Touches on subject of awareness of environmental needs and values. Also includes educational expectations, curriculums, and improvements. Good outline.

32. "The Effect of Growth Rate on Conservation of a Resource." By R. T. Robiscoe. American Journal of Physics. Vol. 41, No. 5:719-720. May, 1973. Grades 7-12.
Derives a formula for the number of years a given resource will last as a function of constant yearly growth rates in the resource usage. Suggests such a calculation to account for environmental problems.

33. "Electricity Demand Growth and the Energy Crisis." By Duane Chapman, Timothy Tyrrell and Timothy Mount. Science. Vol. 178:703-8. November 7, 1972. Grades 7-12.
This article deals with the causes of the energy crisis, projected growth for electrical power for this century, and implications for energy research and development.

34. "Electrochemical Cells for Space Power." By R. M. Lawrence and W. H. Bowman. Journal of Chemical Education. pp. 359-361. July, 1971.

35. "Electrochemical Principles Involved in a Fuel Cell." By A. K. Vijh. Journal of Chemical Education. pp. 680-682. October, 1970.

36. The Encyclopedia of Oceanography. Rhodes W. Fairbridge, editor. Van Nostrand - Reinhold. 1966. $27.50. Junior High to College.
A clearly written one-volume source of information on oceanography that emphasizes the geological aspects of marine environment. Handy reference.

37. Energy. By Irving Adler. John Day Co. 1970. $3.96. Grades 3-6.
Practical examples of changes from one form of energy to another.

38. Energy. By Mitchell Wilson. Time-Life Books. 1967. $5.70. Grade 7 and up.

39. Energy, A Crisis in Power. By John Holdren and Phillip Herrera. Sierra Club. 1972. Paper $2.75.

40. "Energy Action in Haste." Des Moines Register. p. 4. December 4, 1973.

41. Energy and Man's Environment. Thomas F. Ris, editor, 2121 Fifth Avenue, Seattle, Washington 98121. 1973. Elementary and High School.
A series of activities on energy and man's environment to be integrated into the existing curriculum.

42. Energy and Power. Edited by Scientific American editors. W. H. Freeman. pp. 144. 1971. $6.50.

43. "Energy Conservation." By Philip H. Abelson. Science. 178:355. October 27, 1972. Secondary.
The author discusses our dangerous situation because of the dependence on foreign oil for our energy. Attitudinal changes are proposed if we (our society) expect to remain a mobile society.

44. "Energy Conservation and Waste Recycling: Taking Advantage of Urban Congestion." By Eugene Kramer. Bulletin of the Atomic Scientists. Vol. 29, No. 4:13-18. April, 1973. Grades 6-12.
Congested cities can be used to advantage in conserving energy. With present technology, solid wastes can be recycled and used in environmental-industrial parks to supply energy for cities.

45. "Energy Conservation Through Effective Utilization." By Charles A. Berg. Science. Vol. 181:128-138. July, 1973. Grades 6-12.
Discusses various ways in which the demand for energy could be decreased, focusing not so much on discouraging demand by increasing prices as on reducing energy consumption by improving efficiency of energy utilization in buildings and in industry.

46. "Energy Crisis: Environmental Issue Exacerbates Power Supply Problem." By Philip M. Boffey. Science. Vol. 168:1554-9. June 26, 1970. Grades 7-12.
The author discusses the implications of environmental thrusts to energy development. Additional research and development of other energy sources are discussed.

47. "Energy Crisis." Nation's Schools. pp. 31-54. January, 1974.
What four experts say about saving energy through better management and maintenance. Where do we look for waste--a checklist. How six districts are tackling the problem. What to do if you have to close schools down.

48. "The Energy Crisis." By Theodore Weaver. Today's Education. pp. 44-49. January-February, 1974.
The cause and effect of the energy crisis. Short and long term considerations and alternatives relating to energy supply and demand. Prime energy sources other than oil.

49. "The Energy Crisis Is a Blessing." By Michael Malloy. The National Observer. pp. 1, 17. December 6, 1973.

50. Energy, Electric Power and Man. By Timothy J. Healy. Boyd and Fraser Co. 1974. $9.95. Secondary-Adult.
Exploration of numerous potential prime energy sources for use in generating electrical power.

51. Energy into Power: The Story of Man and Machines. By E. G. Sterland. Doubleday. 1967. Grades 6-8.
Search for new sources of energy.

52. "Energy Needs: Projected Demands and How to Reduce Them." By Allen L. Hammond. Science. Vol. 178:1186-8. December 15, 1972. Grades 7-12.
The author reviews a research article dealing with energy usage. Conservation of energy is discussed and suggested methods of conservation explained.

53. "Energy Policy-Making: Limitations of a Conceptual Model." By Irvin L. White. Bulletin of the Atomic Scientists. Vol. 27:20-26. October, 1971. Grades 7-12.
Discusses three major questions directly concerned with energy policy and the improvement of its rationality: Where are we? How did we get here? What can we do about it?

7

54. Energy Potential From Organic Wastes: A Review of the Quantities and Sources. By Larry L. Anderson. Bureau of Mines, Washington, D. C. (068 450). 21pp. July, 1972. Report No.: Bumines-IC-8549; PB-211249. Paper copy available from Government Printing Office--$0.30 as 128.27:8549. NTIS Prices: PC/$2.30; MF/$0.95.

The report itemizes and evaluates for the first time in detail the quantities and sources of moisture- and ash-free organic material contained in manure, urban refuse, industrial wastes, sewage solids, and agricultural wastes in the United States.

55. Energy Recovery from Waste. A municipal-utility joint venture. Saint Louis City/Union Electric Company, Missouri. 20pp. 1972. Grant: GO6-EC-00312. Prepared in cooperation with Horner and Shifrin, Inc. Report Number: PB-213 534/2. Paper copy available from Government Printing Office--$0.40 as EPI.17:36DI. NTIS Prices: PC/GPO; MF/$0.95.

The report discusses the recovery of thermal energy by burning shredded residential solid waste as supplementary fuel in boiler furnaces. Briefly discussed are the process details, the processing facilities, the receiving and firing facilities, the test boiler, and the economics and applicability.

56. "Energy: Shortages Loom, but Conservation Lags." By Constance Holdren. Science. Vol. 180:1155-8. June 15, 1973. Grades 7-12.

The author discussed the techniques the government should employ to help conserve energy.

57. "Energy Shortage Strikes Homes." U. S. News and World Report. pp. 17-19. December 10, 1973.

Chart showing "Where America's Energy Goes."

58. Environmental Education: A Sourcebook. Edited by Cornelius J. Troost and Harold Altman. John Wiley and Sons, Inc. 1972. $11.95. K-12.

Addresses itself to two questions: (1) What is the nature of environmental crisis? and (2) What learning experiences should be provided by this country's schools to meet this crisis? Includes readings, activities, and ideas on ecology and our environment.

59. The Environmental Impact of Electrical Power Generation: Nuclear and Fossil. Edited by John J. McDermott. Pennsylvania Department of Education. 1973. High School.

A mini-course that helps the student gather information about the generation of electrical energy by nuclear or conventional means and draw his own conclusion about the need for this energy supply or an alternative.

60. Experiments with Solar Energy. By Daniel Stephen Halacy. W. W. Norton and Company, Inc. 1969. $4.50. Grades 4-9.

Selection of materials, approximate cost, the construction and operation of devices using solar energy.

61. Exploring Solar Energy. By Raymond A. Wohlrabe. World. 1966. $3.91. Grades 4-9.
Tells how radiation from the sun can be collected and stored, and the many ways it can be used.

62. "Facing Up to Cold Reality." Newsweek. pp. 109-110. November 19, 1973.

63. The First Book of Lumbering. By L. D. Rich. Franklin Watts. 66pp. 1967. $3.95. Grades 4-6.
From early colonial lumbering - forest conservation stressed.

64. The First Book of the Ocean. By S. Epstein. Franklin Watts. 1960. $3.95. Grades 4-6.
Waves, tides, currents, marine biology.

65. The First Book of Oil. By Beatrice Shilstone. Franklin Watts. 1969. $3.75. Grades 4-7.
Petroleum's uses; exploring and drilling for oil; from well to consumer.

66. Forests! Riches of the Earth. By C. William Harrison. Messner. 1969. $3.95. Grades 7-9.
Distribution, uses and abuses of forestry resources.

67. "Fuel Rationing Set: The Way It Will Start: Mandatory Allocation Program." U. S. News. Vol. 75:106-107. October 15, 1973.
Liquefied petroleum gas.

68. Fuel Cells: A Survey. By B. J. Crowe. Computer Sciences Corporation, Falls Church, Virginia. 112pp. 1973. Report Number: NASA-SP-5115, LC-72-600266. Contract: NASW-2173.
A survey of fuel cell technology and applications is presented. The operating principles, performance capabilities, and limitations of fuel cells are discussed. Diagrams of fuel cell construction and operating characteristics are provided. Photographs of typical installations are included.

69. Gifts from the Forest. By Gertrude Wallace Wall. Scribner. 1958. $5.98. Grades 3-7.
From tree to finished product.

70. "Global Effects of Increased Use of Energy." By Alvin M. Weinberg and Philip R. Hammond. Bulletin of the Atomic Scientists. Vol. 28: 5-8, 43-44. March, 1972. Grades 7-12.
This paper speculates on the effects of man's energy releases on world climate.

71. The Great American Forest. By Rutherford H. Platt. Prentice-Hall. 1965. $8.55. Senior High-College.
Ice age and arrival of man; sections on wood, river of sap, and leaf power.

72. "The Great Montana Coal Rush." By Sally Jacobsen. Bulletin of the Atomic Scientists. Vol. 29:37-42. April, 1973. Grades 6-12.
Efforts to uncover big deposits of coal in Montana have created resentment among residents.

73. Gusher; The Search for Oil in America. By Bob and Jan Young. Messner. 1971.
History of oil exploration. Includes discussion of variety of uses for oil.

74. "Harvesting Federal Timber: Report Re-ignites Debate." Congressional Quarterly Service. Weekly Report. 31:2781-22. October 13, 1973. Senior High.

75. "How Schools Can Plus the Energy Drain; Summary of Report." By Educational Facilities Laboratories. Nation's Schools. Vol. 92:10-11. October, 1973.

76. "Hidden Benefits in Fuel-Saving." By Erwin Canham. Des Moines Register. p. 8. November 15, 1973.

77. "Hot Battle Over Natural Gas Controls." Business World. p. 115. October 20, 1973.
Gas, natural (rates).

78. "How They're Solving Our Breeder Reactor's Weird Problems." By A. P. Armagnac. Popular Science. Vol. 203:62-65. August, 1973.

79. "How to Get More Miles Per Gallon of Gas." By T. Tappet. Mechanics Illustrated. Vol. 69:96-98. August, 1973.
Gasoline conservation.

80. How Will We Meet the Energy Crisis? By Reed Millard and the editors of Science Book Associates. Messner. 1971. $4.29.
Power for tomorrow's world. Atom, miniature power plants, rivers, sea, earth, sun.

81. How Your Body Uses Food. National Dairy Council. 28pp. $0.25 per copy. Intermediate.
Graphic art, photographs and text encompassing easy, safe experiments with foods challenge for growth, energy and health. The booklet will find use as an aid to science, health and nutrition studies.

82. "Hydrogen: Its Future Role in the Nation's Energy Economy." By W. E. Winsche and others. Science. Vol. 180:1325-1332. June, 1973. Secondary.
Advocates the development of a hydrogen fuel economy as an alternative to the predominately electric economy based upon nuclear plants and depleting fossil fuel supplies. Evaluates the economic and environmental benefits of hydrogen energy delivery systems in the residential and transportation sectors.

83. Inside the Atom. By Isaac Asimov. Abelard-Schuman. 223pp. 1966. $5.95. Grades 6-9.
General discussion of atoms including future use of atomic power.

84. Inside the Earth. By Phyllis Ladyman. Young Scott Books. 1970. $3.50. Grades 4-up.
Earthquakes, volcanoes, geysers, fumeroles, geothermal steam; useful for teacher's resource.

85. Kingdom of the Tides: The Gigantic Forces that Have Shaped Our Past and Can Determine Our Future. By Samuel Carter III. Hawthorn. 1966. $5.95. Grades 7-up.
The reason for tidal study, its history, types and causes of tides, biological effects of tides, and the effects of tides on man, are all examined.

86. "Laser-Induced Thermonuclear Fusion." By John Nuckolls and others. Bibliography. Physics Today. Vol. 26:46-53. August, 1973.

87. "Latest Threat to the Boom: Shortages Wherever You Look." U. S. News. Vol. 5:70-1. October 29, 1973.
Raw materials, supply and demand.

88. "Learning to Live with Less." Time. pp. 82-84. October 8, 1973.
Availability of natural gas, petroleum: No. 2 oil, home-heating fuels and diesel fuels, liquefied petroleum and propane gas.

89. Let's Find Out About the Ocean. By D. Knight. Franklin Watts. 1970. $3.95. Primary to Intermediate.
Tides, wave motion, currents.

90. "LP Situation: What To Do About It!" Successful Farming. Vol. 71:9. August, 1973.
Liquefied petroleum gas.

91. Lumberjacks of the North Woods. By L. Patterson. Garrard. 1967. $3.08. Grades 3-6.
List of logging camps through legend, ballad, language.

92. "Modern Energy Systems For Existing Schools." American School and University. Vol. 46:38-46. November, 1973.

93. "More Miles From a Gallon of Gas." By P. Stephano. Better Homes & Gardens. Vol. 51:10. September, 1973.
Gasoline - conservation.

94. The Mysterious Sun. By Nigel S. Hey. Putnam. 1971. $3.97. Grades 7-9.
The power of the sun gives life, light - and problems - to earth.

95. Natural Resources: Will We Have Enough for Tomorrow's World. By Reed Millard and the editors of Science Book Associates. Messner. 1972. $4.29. Grades 7-12.
Oil, natural gas; coal, nuclear energy, wood.

96. "New Directions for Solar Energy." By P. E. Glaser and J. C. Burke. Bulletin of Atomic Science. Vol. 29:40-2. October, 1973.
Solar energy.

97. "New Environmental Science Educational Approach; National Center for Resource Recovery Educational Program Kit." By J. V. Bernardo. Science Teacher. Vol. 39:25-26. December, 1972.

98. "Now, a Change in Wasteful Habits." Time. p. 51. October 29, 1973.
Conservation with respect to transportation, heating, and electricity.

99. "Nuclear Fusion: World's Hope for Cheap, Clean Plentiful Power." By D. G. Lee. National Wildlife. Vol. 11:12-14. October, 1973. Secondary.

100. Nuclear Science. Pennsylvania Department of Education. 1971. Secondary.
Introduction of a nuclear science course into high school. Designed to present a basic but comprehensive understanding of the atom in light of modern knowledge.

101. The Oceans in Tomorrow's World; How Can We Use and Protect Them? By David Reuben Michelsohn and the editors of Science Book Associates. Messner. 1972. $4.95. Grades 7-up.
Includes use of sea gradient and tides in chapter on "Power from the Sea."

102. Of Rivers and the Sea. By Herbert E. French. Putnam. 1970. $6.95.
Includes reference to origins and mechanics of lakes, rivers, waterfalls, hot and cold springs.

103. "Oil Allocation: How Fair?" Newsweek. pp. 93-100. December 10, 1973.

104. "Organic Courses Take the 'F' Out of Refuse; Teaching Children How to Make Use of Refuse." Nation's Schools. Vol. 90:49. September, 1972. K-6.

105. "The Other Shortage." Time. pp. 40-45. January 7, 1974.
Natural gas availability in the U. S.

106. "The Painful Change to Thinking Small." Time. pp. 19-25. December 31, 1973.

107. The Picture Book of Oil. By Anita Brooks. John Day Co. 1965. $4.68. Grades 4-7.
The story of the petroleum industry. The men and machines which are used in the search, drilling, refining, processing, and distribution of petroleum products.

108. Plants Without Leaves. By Ross E. Hutchins. Dodd. 152pp. 1966. $3.75. Grades 5-up.

109. "Powerful Pulse of Laser Light: Step Toward Fusion." Science News. Vol. 104:199. September 29, 1973.

110. Process for Converting Solid Wastes to Pipeline Gas. By Herman F. Feldmann. Department of the Interior, Washington, D. C. (109 950). Government-owned invention available for licensing. Report Number: PB-220 993/0. Copy of patent available from Commissioner of Patents, Washington, D. C. 20231, $0.50.

The invention relates to the conversion of municipal solid wastes and other wastes to high B.T.U. gas. Solid wastes are heated to 500C-675C. At 1000-3000 P.S.I.G. in presence of gas containing at least 90 mole percent hydrogen to convert said wastes to a methane-and ethane-containing gas having no condensable oils and tars. The carbonaceous residue is also free of tars and oils. (Modified author abstract)

111. Proposed Establishment of Priorities of Use and Allocations of Supply for Certain Low Sulfur Petroleum Products. Draft Environmental Impact Statement. Energy Policy Office, Washington, D. C. 31pp. September 7, 1973. Report Number: EIS-AA-73-1586-D. NTIS Prices: PC/$3.00.

The statement concerns a proposed action which would temporarily prohibit utilities and other large fuel users from switching from coal or residual fuel oil to lower sulfur petroleum fuels and prohibit increases in the quantity of distillates blended into residual oils, except where such actions are absolutely necessary to meet primary ambient air quality standards.

112. The Prototype Oil Shale Leasing Program. Volume II. Energy Alternatives. Final Environmental Impact Statement. Department of the Interior, Washington, D. C. (109 950). 282pp. August 29, 1973. Report Number: EIS-AA-73-1423-F-2. Paper copy available from Government Printing Office, $2.85 as Stock Number SN 2400-00784. NTIS Prices: PC-GPO, MF/$1.45.

Abstract: This action would make available for private development up to six leases of public oil shale lands of not more than 5,120 acres each. Two tracts are located in each of the states of Colorado, Utah, and Wyoming. Oil shale development would produce both direct and indirect changes in the environment of the oil shale region in each of the three states where commercial quantities of oil shale resources exist.

113. "Recycling Solid Waste in Chattanooga." By R. Vredeveld and R. Martin. American Biology Teacher. Vol. 35:84-87. February, 1973.

114. A Sand County Almanac. By Aldo Leopold. Oxford University Press. 1966. $7.50. Intermediate, Secondary.

Fictional story of the joy and beauty found in a style of life that protects the environment. Also, short essays on conservation.

115. "Scarcity of Energy." By Philip H. Abelson. Science. Vol. 169:1267. September 25, 1970. Grades 7-12.

Energy production is discussed and the research needed for coal usage is suggested. Governmental expenditure for coal research is suggested.

116. The Sea Around Us; A Special Edition for Young Readers. By Rachel Carson and adapted by Anne Terry White. Oxford University Press. 1961. $7.50. Grades 5-up.
Currents, tides, marine life.

117. "Some Fuel-Saving Ideas You Haven't Heard About Yet." By August Gribbin. The National Observer. p. 3. November 17, 1973.

118. The Story of the Atom. By Mae and Ira Freeman. Random House. 81pp. 1960. $3.47. Grades 4-6.
An explanation of molecular and atomic structure, the splitting of the atom, and modern nuclear research. Emphasizes peace-time use of atomic energy.

119. "Tennessee Valley Authority After 40 Years." By P. Barnes. New Republic. Vol. 169:15-18. November 10, 1973.

120. "Thermonuclear Fission." Scientific American. Vol. 229:48. November, 1973.
Nuclear fission.

121. Things Are Made to Move. By Illa Podendorf. Children's Press. 1970. $4.50. Grades 1-3.
Force and energy.

122. The True Book of Energy. By Illa Podendorf. Children's Press. 1964. $4.50. Grades 2-5.
Energy in moving water, wind and sunlight which man has learned to use.

123. The True Book of Rivers. By Norman and Madelyn Carlisle. Children's Press. 1967. $4.50. Grades 2-4.
Includes how used to produce electricity.

124. "Understanding on Offshore Oil." By L. J. Carter. Science. Vol. 182: 564. November 9, 1973.
Oil and gas leases
Geothermal
Solar energy

125. "Unsheathing the Political Weapon." Time. pp. 46-51. October 29, 1973.
Oil supply - chart contrasting 1962 with 1972.

126. U. S. News and World Report. Numerous Articles. pp. 9, 11, 13, 14, 21, 31, 32, 49. December 31, 1973.

127. United States Petroleum Situation Through 1980. By Robert W. Heubner. Army War Coll. Carlisle Barricks, Pa. (403565). 54pp. March 14, 1973. Report Number: AD-761 576. NTIS Prices: PC/$3.00; MF/$0.95.
The paper examines the current and projected United States petroleum and natural gas requirements through 1980. These two resources account for three-fourths of all the energy consumed in the United States. The unprecedented rate at which they are being consumed has caused an imbalance between demand and supply and presents the nation with an energy problem of serious and growing proportions.

128. Waves. By Herbert Zim. Morrow. 1967. $3.78. Grades 4-6.
Brief useful introduction - tidal waves, underwater earthquakes.

129. What Is Heat? By Theodore W. Munch. Benefic. 1960. $2.40. Grades 4-8.
Natural and artificial sources of heat, heat and motion, measurement techniques and importance of heat to man.

130. "What U. S. Can Do to Tap Energy Sources Closer Home." U. S. News and World Report. pp. 25-26. December 3, 1973.
Availability of energy sources in both the U. S. and world - oil, crude shale oil.

131. "When Your Job Hinges on Oil..." By James G. Driscoll. The National Observer. pp. 1, 12. December 22, 1973.

132. The Whole Earth Energy Crisis: Our Dwindling Sources of Energy. New edition. By John H. Woodburn. G. P. Putnam's Sons. 1973. $4.89. Grades 7-12.
Contents: Energy troubles loom; Energy from the sun; Natural gas; Energy from petroleum; Energy from coal; Energy from storms; Other forms of energy; Getting it all together.

133. "Wonder Fuel; Hydrogen Powered Auto Engines." Newsweek. Vol. 82:75. November 12, 1973.
Auto fuel.

134. The Wonders of Algae. By Lucy Kavaler. John Day Co. 96pp. 1961. $4.50. Elementary.

135. The World of Power and Energy. By Frank Ross. Lothrop, Lee and Shepard. 1967. $4.32. Grades 6-8.
Sun, sky, water, earth, fossil fuels, chemical and atomic energy; Energy from the Depths of the Earth.

136. "You Can't Fuel All the People; Allocation Program." Newsweek. Vol. 82:85-86. October 15, 1973.
Liquefied petroleum gas.

Section Three: A selected list of audiovisual materials. Sixteen millimeter titles are listed with the name of the distributor, where they can be purchased. The user must seek a rental source.

1A/V. Atom and Its Nucleus. (Series of 7 filmstrips) Color. Jam Handy Organization. 1965. $42.00. Elementary.
Clear and detailed step-by-step explanation of nuclear structure and phenomena. (1) Exploring the atom. (2) Discussing isotopes. (3) What is radioactivity? (4) Radioactive transmutation. (5) Bombarding the nucleus. (6) Secret of nuclear energy. (7) Using nuclear energy.

2A/V. Atoms and Their Energy. (Series of 4 filmstrips) Color. Captioned. From Science Adventures Series. Filmstrip House. Set, $20.00. Intermediate-Junior High.
Discusses the atom, showing how atoms differ. Describes properties of elements and radioactivity. Depicts the principle of an atomic furnace and the meaning of fission and chain reaction. (1) Atoms, Atoms Everywhere. (2) Elements - What Are They? (3) Radioactive Isotopes. (4) Putting Atoms to Work.

3A/V. Banquet of Life. (Motion Picture) 16mm. Black & White. 60 min. Indiana University. 1967. Secondary.
Population is exploding faster than resources of earth can cope with it. Malnutrition, jammed cities, littered landscapes, and polluted environment are happening. Improvements in agriculture, health, and nutrition result in further explosion. Moral questions arise. The birth rate must be controlled one way or another. A thought provoking film for use in developing concerns over world population and the capability of this earth to support growing populations.

4A/V. Basic Concepts in Science. Level I Series. (8mm film loops) Silent. Color. 4 min. Eye Gate House, Inc. 1969. Primary-Intermediate.
Air can move.
Air is all around us.
Air takes up space and air can do work.
Designed for the beginning investigator.

5A/V. Caverns and Geysers. (Motion Picture) 16mm. Color. 13 min. BFA Educational Media. 1961. Intermediate-Secondary.
Illustrates how underground water constantly changes earth. Includes views of hot springs and geysers created when volcanic rock heats water underground.

6A/V. Coal. (Motion Picture) 16mm. Color. 26 min. NBC Educational Enterprises. 1973. Purchase $240.00; Rental $30.00. Junior-Senior High.
Our most plentiful fossil fuel, but also the dirtiest and most destructive to mine.

7A/V. Conservation for Today's America. (Filmstrip) 7 filmstrips. Color. 4 phonodiscs. 12" 33rpm or 4 cassettes. Society for Visual Education. 1967. $65.00. Intermediate-Advanced Elementary.
Includes mineral conservation.

8A/V. Ecology: Understanding the Crisis. (Series of 6 sound filmstrips) Disc or cassette, automatic and manual. Color. 82 frames. 9 min. each. With teacher's guide. Encyclopaedia Britannica Education Corporation. With disc, $70.20 series; $13.00 each. With cassette $80.70 series; $14.95 each. Preview available. Grades 8-12.

Environments and Ecosystems, Man in Ecosystems, Human Communities Simple and Complex, Creating Imbalances, Destroying the Future, Creating the Future.

9A/V. Electricity from Heat and Sunlight. (8mm film loop) Color. With teacher's guide. Doubleday Multimedia. $23.50. Grades 4-12.

Shows how electricity can be produced from heat and sunlight.

10A/V. Energy. (Motion Picture) 16mm. Color. Sound. 12 min. Pyramid Film Production. 1970. Junior-Senior High.

A visual demonstration of power systems and the transformations of energy. Highlights the power system of the past, present, future.

11A/V. Energy and Power - A First Look. (Motion Picture) 16mm. 10 min. Journal Films. 1962. Primary-Intermediate.

Outlines from the days of the caveman to the present, many ways in which man harnesses energy and increases his capacity to do work by utilizing the potential energy found in wood, wind, and running water.

12A/V. Energy Crisis. (Motion Picture) 16mm. Color. 13 min. Journal Films. 1972. Intermediate-Junior High.

Reviews the different energy sources and indicates the length of time we may be able to depend on them. Shows the possibility of solutions and developments which may someday provide unlimited power to meet our needs.

13A/V. The Energy Game. (Motion Picture) 16mm. Color. Sound. 52 min. American Association for Advancement of Science. 1972.

Shows scientists discussing the energy shortages in the U. S. and the role atomic power plants have played in the problem. (From the Science 71--A Report to the Nation Series.)

14A/V. Energy - Toward the Age of Abundance. (Motion Picture) 16mm. Color. Sound. 22 min. University of California Extension Media Center. 1971.

Explains that 1/5 of the world's population in Japan, Europe and North Africa consume over 60% of all the power on earth, 10 times as much per capita as the other 4/5. Predicts that in 10 years, North America will consume more energy than it has in all its history. Suggests as possible energy sources the nuclear fission plant, fusion reaction and the use of tidal power and solar energy.

15A/V. First Film on the Wind. (Motion Picture) 16mm. Color. Sound. 9 min. BFA Educational Media. 1966.

Shows how, though one cannot see the wind, he can see what the wind does, such as making waves on the water, swaying trees, and lifting kites. Shows how rain clouds come and go with the wind.

16A/V. The Forest Community. (Series of 6 filmstrips) Color. McGraw-Hill. 1964. $42.00, set; $7.50, each. Intermediate-Advanced Elementary.

Building the Soil, 51 frames; Where Trees Grow, 52 frames; How Trees Grow, 53 frames; Forest Plant and Animal Relationships, 48 frames; Enemies of the Forest, 49 frames; Forests for the Future, 54 frames.

17A/V. The Garbage Game. (Academic Game) 2-6 players. Educational Ventures Inc. $7.00. K-6.

18A/V. Geyser Valley. (Motion Picture) 16mm. Color. Sound. 9 min. Encyclopaedia Britannica Education Corporation. Grades 5-10.

Taken at Yellowstone - no narrative - suitable for creative writing or science.

19A/V. The Great Search: Man's Need for Power and Energy. (Motion Picture) 16mm. Color. 13 min. With teacher's guide. Walt Disney Production. 1972. Grades 4-up.

Traces history of man's attempts to harness energy of sun, water, lightning, etc. in order to produce power needed for daily living.

20A/V. House of Man--Part II, Our [illegible]wded Environment. (Motion Picture) 16mm. Color. Sound. 11 min. Encyclopaedia Britannica Education Corporation. 1969. Intermediate-Senior High.

Shows the problems that have resulted from the population explosion of the 20th Century; housing and food shortages; poverty; pollution; industrial waste; exploitation of natural resources. But technological understanding is increasing, medical discoveries, mechanical abilities, scientific exploration of the world are causing an explosion in knowledge.

21A/V. How Clear the Hot Springs Bubble. (Motion Picture) 16mm. Color. Sound. 13 min. International Film Bureau. 1972. Grades 7-12.

Thermal energy - Icelands' and others geysers and hot springs. See December 15, 1972, Booklist, p. 397.

22A/V. The Last Pony Mine. (Motion Picture) 16mm. Color. Sound. 23 min. Film Production Unit, Iowa State University. Rental from Media Resources Center, Iowa State University.

Iowa's Coal Mining Heritage. By Dorothy Schwieder and Richard Kraemer Film Production Unit, Iowa State University. $275. Junior-Senior Hig

This booklet is a guide to the film, "The Last Pony Mine." It also includes a general reference on coal and student activities. The price listed is for the film.

23A/V. Learning About Conservation. (Series of 6 filmstrips) Phonodiscs or cassettes. Coronet Instructional Films. $60.00, with 6 cassettes; $45.00 with 3 records. 1968. Intermediate-Junior High.
Includes few minerals and energy resources.

24A/V. Oceanography. (2 filmstrips) Phonodisc or cassette. Color. Educational Activities. 1969. $20.00. Grades 4-9.
Tides, currents, effect on climate, food, fuel and minerals for man.

25A/V. Oceanography. (Series of 5 film loops) 8mm. Animated. Silent. Color. Cartridge. BFA Educational Media. 1971. $24.00 each. Intermediate-Advanced Elementary.
Currents, orbital motion, growth of sea waves.

26A/V. Petroleum and Coal. (Filmstrip) Color. 64 frames. From Using Natural Resources Series (6 filmstrips). Ward's Natural Science Establishment. 1966. Junior-Senior High.
Shows the vital importance of petroleum and coal.

27A/V. Power. (Filmstrip) Color. Sound with cassette or record. 53 frames. From Water and How We Use It Series. Coronet Instructional Films. 1971. 6 filmstrips with cassettes, $70.00; with records $55.00. Intermediate-Junior High.
Shows how water power helped the development of early industry and how water supplies power for hydroelectric energy from the water and how we use it.

28A/V. Power and Energy. (Set of 2 filmstrips) Disc or cassette. Automatic and manual. Color. 50-59 frames. 18-20 min. with teacher's guide. Educational Activities. $25.00 a set. Grades 5-9.
Answers such questions as: Where does energy come from? How is it produced and distributed? Why are there "Brownouts?" How do you produce power from fossil fuels, fission, fuel cells, ocean, solar energy? What pollution problems will increased energy production cause?

29A/V. The Power and Energy Crisis - Technological Challenge of the Future, Part I, Part II. (Filmstrip) Color. Sound. Audio Tape. 103 frames. Scott Education Division. 1972. Junior-Senior High.
Features leading scientists, ecologists, and public officials discussing the problems involved in supplying the power and energy requirements for the growing United States.

30A/V. Tidal Power. (Motion Picture) 16mm. Sound. Color. 22 min. 1959. United States Corps of Engineers. For sale by U. S. National Audiovisual Center.

31A/V. Trees. (Series of 6 filmstrips) Color. Phonodisc or cassette. 10 min. 46 frames. Coronet Instructional Films. 1970. With cassette, $65.00 a set; with records, $50.00 a set. Intermediate-Junior High.
Deciduous and coniferous, identify; commercial use; watershed.

32A/V. Water and How We Use It. (Series of 6 filmstrips) Color. Phonodisc or cassette. Coronet Instructional Films. 1972. With cassettes, $72.00; with records, $57.00. Grades 4-9.

Describes the various areas in which we use water and the results of heavy use of this resource. How hydroelectric energy is created, irrigation; transportation; recreation.

33A/V. Winds and Air Currents. (Filmstrip) Color. 43 frames. Popular Science Publishing Company. 1970. Elementary-Junior High.

Pictures what wind is, what causes winds and air currents, what they can do, and how they affect weather.

Section Four: Addresses of publishers.

Abelard-Schuman, Ltd., 257 Park Avenue Street, New York, New York 10010.

American Association for Advancement of Science, 1776 Massachusetts Avenue, N.W., Washington, D. C. 20036.

Benefic Press, 10300 West Roosevelt Road, Westchester, Illinois 60153.

BFA Educational Media, 2211 Michigan Avenue, Santa Monica, California 90404.

Boyd and Fraser Publishing Company, 3627 Sacramento Street, San Francisco, California 94118.

Children's Press, 1224 West Van Buren Street, Chicago, Illinois 60607.

Coronet Instructional Films, 65 E. South Water Street, Chicago, Illinois 60601.

Creative Educational Society, Inc., 515 North Front Street, Mankato, Minnesota 56001.

Day, John, Company, Inc., 257 Park Avenue Street, New York, New York 10010.

Dodd, Mead, and Company, 79 Madison Avenue, New York, New York 10016.

Doubleday and Company, Inc., 277 Park Avenue, New York, New York 10017.

Doubleday Multimedia, 1370 Reynolds Avenue, Santa Ana, California 92705.

Educational Activities, Inc., Activity Records, P. O. Box 392, Freeport, New York 11520.

Educational Ventures, Inc., Middletown, Connecticut 06457.

Encyclopaedia Britannica Education Corporation, 425 N. Michigan Avenue, Chicago, Illinois 60611.

Environmental Protection Agency, Office of Public Affairs, 1750 K Street, N.W., Washington, D. C. 20460.

Eye Gate House, Inc., 146-01 Archer Avenue, Jamaica, New York 11435.

Film Production Unit, Iowa State University, Ames, Iowa 50010.

Filmstrip House, 425 Park Avenue South, New York, New York 10016.

Freeman, W. H., and Company, Publishers, 660 Market Street, San Francisco, California 94104.

Garrard Publishing Company, 1607 N. Market Street, Champaign, Illinois 61820.

Harper and Row, Publishers, 10 East 53 Street, New York, New York 10022.

Hawthorn Books, Inc., 260 Madison Avenue, New York, New York 10016.

Iowa Department of Soil Conservation, Grimes State Office Building, Des Moines, Iowa 50319.

Jam Handy School Service, Inc., 2781 E. Grand Boulevard, Detroit, Michigan 48211.

Lothrop, Lee and Shephard Company, Division of William Morrow and Company, Inc., 105 Madison Avenue, New York, New York 10016.

McGraw-Hill Book Company, 1221 Avenue of the Americas, New York, New York 10020.

McGraw-Hill Textfilms, 330 W. 42nd Street, New York, New York 10036.

Messner, 1 West 39 Street, New York, New York 10018.

Morrow Publishers, 4167 Market Street, San Diego, California 92102.

NBC Educational Enterprises, 30 Rockefeller Plaza, New York, New York 10020.

National Dairy Council, 111 North Canal Street, Chicago, Illinois 60606.

National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

Norton, W. W. and Company, Inc., 55 Fifth Avenue, New York, New York 10003.

Oxford University Press, Inc., 200 Madison Avenue, New York, New York 10016.

Pennsylvania Department of Education, Box 911, Harrisburg, Pennsylvania 17126.

Popular Science Publishing Company, 355 Lexington Avenue, New York, New York 10017.

Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632.

Putnam's, G. P., Sons, 200 Madison Avenue, New York, New York 10016.

Random House, Inc., 201 East 50 Street, New York, New York 10022.

Ris, Thomas F., 2121 Fifth Avenue, Seattle, Washington 98121.

Scott Education Division, 104 Lower Westfield Road, Holyoke, Massachusetts 01040.

Scribner, Charles, Sons, 597 Fifth Avenue, New York, New York 10017.

Sierra Club Books, 597 Fifth Avenue, New York, New York 10017.

Society for Visual Education, Inc., Division of the Singer Company, 1345 Diversity Parkway, Chicago, Illinois 60614.

Steck-Vaughn Company, Box 2028, Austin, Texas 78767.

Time-Life Books, Division of Time, Inc., Time and Life Building, Rockefeller Center, New York, New York 10020.

University of Michigan Press, Ann Arbor, Michigan 48106.

U. S. Atomic Energy Commission, Washington, D. C. 20202.

U. S. Environmental Protection Agency, Washington, D. C. 20202.

U. S. Government Printing Office, Division of Public Documents, Washington, D. C. 20402.

Van Nostrand Company, 450 W. 33rd Street, New York, New York 10001.

Viking Press, Inc., 625 Madison Avenue, New York, New York 10022.

Ward's Natural Science Establishment, 300 Ridge Road East, Rochester, New York 14622.

Watts, Franklin, 845 3rd Avenue, New York, New York 10022.

Wiley, John and Sons, Inc., 605 Third Avenue, New York, New York 10016.

World Publishing Company, 110 East 59 Street, New York, New York 10022.

Young Scott Books, Addison-Wesley Publishing Company, Inc., Reading, Massachusetts 01867.

PART II

ENERGY IN THE SOCIAL ENVIRONMENT: A GUIDE TO RESOURCE MATERIAL

PART II

ENERGY IN THE SOCIAL ENVIRONMENT: A GUIDE TO RESOURCE MATERIAL

Alternative Sources for Use in the Preparation of Instructional Materials/Activities in an Energy Awareness Unit

Instructional materials identified in this section of the guide have been prepared to assist classroom teachers in developing and enriching an energy awareness lesson/unit.

A. National, Regional and State Agencies

The professional organizations listed in this section of the guide are not intended to be exhaustive or restrictive. (USERS ARE ENCOURAGED TO CONTACT THE ORGANIZATION INDICATED FOR ACQUISITION OF MATERIALS DESCRIBED BELOW.)

Center for War/Peace Studies

Person to Contact: Thomas Collins

Address: 218 East 18th Street
New York, New York 10003

Materials: The Quality of Life: Three Case Studies on Life Styles and Ecology. David C. King. 50¢. A booklet containing a series of 1-day case studies; plus discussion questions, research and resource suggestions. For use in such courses as American Studies, Current Affairs, Sociology, and others. The scenarios can be reproduced for distribution to the students.

Environmental Studies Curriculum Project

Person to Contact: Write to Essentia

Address: The Evergreen State College
Olympia, Washington 98505

Telephone: (206) 866-6570

Materials: All materials have been tested from first grade through graduate school and are intended for those grade levels. Materials are: Packets 1 and 2 ($10.00 per set) - 50 assignment cards that are multi-disciplinary invitations to explore and learn from your immediate environment plus a teacher's non-guide ESSENCE-ESSENSE; Packets 3 and 4 ($10.00 per set) - 25 assignment cards related to interpersonal relations, 40 extension cards to be used with

Packets 1 and 2. ESSENSE 2 - a teacher's workbook, classroom poster for student plotting of their extension activities. Poster Packet ($4.00 per packet) - 10 posters related to attitudes characteristic of openness and humanistic education. FREE MATERIALS: Newsletter, Sensorsheet, published 4 times a year.

ERIC Clearinghouse for Social Studies/Social Science Education (ERIC/ChESS)

Person to Contact: Robert Fox, Director

Address: Educational Resources Center
855 Broadway
Boulder, Colorado 80302

Materials: Environmental/Ecological Education. Lois B. Watt and Myra H. Thomas. $3.29. A bibliography of fiction, nonfiction and textbooks for elementary and secondary schools.

Using Government Documents to Study the Quality of Life. Carol Sarabun, Thomas Ward, and Richard Pitner. A discussion in the use of government documents when studying environmental issues. Regional offices and addresses of the Government Printing Office are provided for quick and easy access to users of government documents.

Far West Laboratory for Education Research and Development

Person to Contact: Ms. Ferucia Freschlet OR U. S. Government Printing Office
Washington, D. C. 20402

Address: No. 1 Garden Circle
Berkeley, California 94705

Stock Number 1780-1072
Money Order or Government Coupons Required - $8.95

Telephone: (415) 841-9710

Materials: A Source Book of Elementary Curricula Programs and Projects (ALERT). Samuel Henrie, Senior Editor, et. al. A curriculum material analysis of twelve environmental education products are given in Chapter Seven of this Source Book.

Iowa Department of Public Instruction

Person to Contact: Richard E. Gage

Address: Curriculum Division
Department of Public Instruction
Grimes State Office Building
Des Moines, Iowa 50319

Telephone: (515) 281-3264

Services: An ERIC (Educational Resources Information Center) data bank is located in the Media Section of the Iowa Department of Public Instruction. This is a national information system which disseminates research results, research-related materials, and other research information.

Local school personnel, teachers, curriculum personnel and administrators are urged to use the ERIC reference material in locating curriculum materials/projects related to environmental education (energy crisis), at their regional media center.

The following document abstracts are only representative of the vast amount of research available. If complete microfiche document is desired of entries listed below, please complete the Retrieval Request Form (See p. 62) by checking appropriate ED number. Return this form to: Richard E. Gage, Curriculum Division, Department of Public Instruction, Grimes State Office Building, Des Moines, Iowa 50319.

- ED 068 325

Guidelines for Curriculum Development--Environmental Education K-12, Part I, Concepts, Ideas, Objectives and Principles

Broward County School Board, Fort Lauderdale, Fla.

Spons Agency--Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D. C.

Pub Date May 72

Note--33 p.

Descriptors--*Curriculum Development, Ecology, Elementary Grades, *Environmental Education, *Fundamental Concepts, *Guidelines, Problems, Secondary Grades

Identifiers--Elementary Secondary Education Act Title III, ESEA Title III

Research into the problems, causes, and possible solutions to the environmental crisis confronting mankind led to the development of these guidelines for curriculum development by the interdisciplinary Environmental Education Project of Broward County, Florida. The purpose of the research was to determine the role that could be played by the educational community and to identify those aspects of the problem that should be given major emphasis. This booklet contains Part I of a three-part publication. It is a compilation of the basic concepts upon which the entire program is based. It also includes the major environmental problems with which we are or will be confronted, the alternatives, and the possible solutions to these problems. It is sufficiently general, in scope and content, to be of value to those having responsibility for curriculum development. Parts II and III deal with classroom/outdoor activities and community resources and involvement. This work was prepared under an ESEA Title III contract.

- ED 068 348

Kroll, Claudia J.

An Environmental Unit for the Social Studies.

Pub Date 72

Note--62p; Due to copyright restrictions, pages 49-56 are not included

Descriptors--*Environmental Education, *Land Use, Resource Materials, *Secondary Grades, *Social Studies, Teaching Guides, *Unit Plan

Based on the inquiry method of learning, this instructional unit attempts to encourage students to discover for themselves the facts, problems, values, conflicts, and potential solutions of an environmental issue. Specifically, it deals with surface mining in the United States, with special focus on surface mining in Illinois. Materials and instructional strategies necessary for actual classroom use are presented, serving as a source of ideas and procedures for the teacher. Although planned for use in high school social studies classes, it may be adapted for other disciplines or integrated into other units. Chapter 1 defines the purpose, importance, significance, and terms of the topic and unit. Chapter 2 provides behavioral objectives, a list of instructional aids included in the unit, introductory activities, activities to provide further information, accumulative activities, and a means of student evaluation. Summary and conclusions are contained in Chapter 3. Appended material includes a list of free materials to send for and ten instructional aids: a questionnaire, test, coal production charts, mining terms, statements by governmental personnel, a slide presentation explanation, conflicting views on strip mining, a bibliography, and two magazine articles.

- ED 071 856

Alternatives for Man and Environment, Revised Curriculum.

Miami-Dade Junior College, Florida

Spons Agency--Bureau of Educational Personnel Development (DHEW/OE), Washington, D. C.

Pub Date 72

Note--186p.

Descriptors--Course Content, Curriculum Development, *Curriculum Guides, Ecology, *Environmental Education, Environmental Influences, *Interdisciplinary Approach, *Post Secondary Education, Social Sciences, *Units of Study (Subject Fields)

Identifiers--Florida, Miami-Dade Junior College

A one-year general education course entitled "Man and Environment" has been developed at Miami-Dade Junior College, Florida. Basic framework for the course was built on the premise that an interdisciplinary, module-structured course represents one of the better approaches to planning environmental education curriculum. Material for the course may be found in "Man and Environment, Revised Curriculum," ED 056 930. Utilizing the modular form and topical areas of Man and Environment, this booklet, however, presents variations, or alternatives, for the modules. Twenty topical areas are covered: ecological imperatives; value systems--ecological priorities; belief systems; the myths of technology; earth as an energy system; conservation of vital resources; population dynamics; urbanization: the living community; urban environment; water--supply, demand and pollution; air pollution; food and drug pollution; sound pollution; scenic pollution; wildlife and man; soil and man; intergroup tensions; impact of political systems; impact of economic systems; and media and the environment. Each section offers one to five alternatives, outlining an overview of the module, concepts to be developed, student objectives (learning activities), and a list of resource materials. Where appropriate, a chart is constructed indicating each concept, strategy for developing it, and suitable evaluation procedure. A bibliography is included.

- ED 072 666

Dimensions of Change.

Kaiser Aluminum and Chemical Corp., Oakland, Calif.

Pub Date 71

Note--230p.

Available from--Glencoe Press, 8701 Wilshire Blvd., Beverly Hills, California 90211

Descriptors--Changing Attitudes, *City Problems, Communication (Thought Transfer), *Ecology, *Energy, Food, Housing, Institutional Role, Social Change, *Social Problems, Technological Advancement, *Technology, Telecommunication, Transportation

When six crucial problem areas--ecology, shelter, energy, food, mobility, and telecommunications--were investigated to learn whether there are technological solutions to these problems, the results were discouraging. That is, there are technological solutions to many of these problems, but in none of these fields, with the possible exception of communications, are they being used in any significant way, nor is there any indication that they might be in the next three decades. The reason for this situation appears to be that the imposition of institutions--governmental, religious, educational, and corporative--which were formed in agrarian times, does not allow a technological solution to function anywhere nearly as efficiently as it could. This book takes the form of six essays, put together in college style, incorporating graphics and quotations as well as text. The sixth essay, "Telecommunications," is discussed more fully in EM 010 784.

- ED 075 163

The Economy, Energy, and the Environment. A Background Study.

Joint Economic Committee, Washington, D. C.

Pub Date Sept. 70

Note--139p.

Available from--Superintendent of Documents, Government Printing Office, Washington, D. C. 20402 ($0.55)

Descriptors--*Economics, *Electricity, *Energy, *Environment, Environmental Influences, Federal Government, Fuels, Natural Resources, *State of the Art Reviews, Technology, Utilities

This study surveys the existing literature related to various technical aspects of electric power production, with primary emphasis on the supply of the various fuels used in the production of electricity and on the environmental consequences of energy conversion. It was prepared by the Environmental Policy Division, Legislative Reference Service, Library of Congress, at the request of the Congressional Joint Economic Committee for use as background material in the Committee's investigation of the economic aspects of electric power production. A wide range of issues are identified and discussed, issues classified as operational, economic, technological, environmental, resource, and regulatory. Statistical data and legislative references frequently supplement the narrative material.

- ED 077 704

Energy/Environment/Economy. An Annotated Bibliography of Selected U. S. Government Publications Concerning United States Energy Policy.

ENVIRO/INFO, Green Bay, Wis.

Pub Date Apr. 73

Note--24 p.

Available from--ENVIRO/INFO, P. O. Box 115. Green Bay, Wisconsin 54305 ($2.00)

Descriptors--*Annotated Bibliographies, *Economics, *Energy, *Environment, Federal Government, *Government Publications, Indexes (Locaters), Policy, Reference Materials

This annotated bibliography attempts to provide a selective listing of 109 U. S. federal government publications germane to the energy crisis and its attendant environmental and economic implications. Primary emphasis is placed upon documents presenting energy policy issues which have emerged, plus statistical reportage which provides quantitative substantiation. Documents of a technical nature are generally avoided, although sections of some items include such material. Information for each entry includes title of the publication, source, date, pages, Superintendent of Documents number or National Technical Information Service number, price, and annotation. Items found in federal depository libraries are so noted. Most of the items listed were issued during the period 1970 through the first quarter of 1973, with a few exceptions.

- ED 077 705

Amidet, Rosemary E., Comp.

Environment: The Human Impact. Selections from "The Science Teacher."

National Science Teachers Association, Washington, D. C.

Pub Date 73

Note--259p.

Available from--NSTA, 1201 Sixteenth Street, N.W., Washington, D. C. 20036 ($5.00 Stock No. 471-14644)

Descriptors--Anthologies, *Ecology, *Environment, *Environmental Education, *Essays, *Humanization, Natural Resources, Problem Solving, Secondary Grades

Selections from "The Science Teacher" magazine, appearing generally between January 1970 and May 1972, are offered in this compilation. Articles are divided into four sections: (1) A Point of View--personal perspectives on the nature and scope of the environmental problem, (2) Aspects of the Problem--relevant background material, (3) Environmental Education--course descriptions and curricula, (4) Student Activities--research projects and classroom ideas, and (5) Resources for Curriculum Guiding--book reviews and notes about other available materials. Subject content is wide-ranging, from ecology, energy and power, pollution and waste disposal, health, and natural resources to urbanization, population and food supply, transportation, architecture, industrialization, and technology. The 66 articles present a variety of viewpoints about causes and solutions to environmental situations and problems and illustrate a variety of approaches that science teachers at the secondary level are using to increase student awareness of the dilemmas and some of the choices that face society today.

- ED 070 606

Nuclear Power and the Environment

International Atomic Energy Agency, Vienna (Austria).

Pub Date 72

Note--92p.

Descriptors--Bibliographic Citations, *Conference Reports, *Energy, Environmental Education, Health Education, *Public Health, *Radiation, *Safety, Science Education

This booklet is a summary of an international symposium, held in August 1970 in New York City, on the environmental aspects of nuclear power stations. The symposium was convened under the sponsorship of the International Atomic Energy Agency (IAEA) and the U. S. Atomic Energy Commission (USAEC). The information is presented in a condensed and readily understandable form, and it is hoped that it will be useful to those interested in a summary view of the public health and environmental aspects of nuclear power production.

Contents are organized according to major headings as follows: "The Role of Atomic Energy in Meeting Future Power Needs," "Radiation Protection Standards," "Safe Handling of Radioactive Materials," "Other Impacts," "Public Health Considerations," and "Summary." Included in the summary are lists of "pertinent publications" of the IAEA, the World Health Organization (WHO), other international bodies, and a list of consultants and contributors. In addition to the symposium summary, this booklet also contains contributions supplied by 28 experts from IAEA and WHO and a number of member states.

- ED 070 607

Nuclear Energy and the Environment.

International Atomic Energy Agency, Vienna (Austria).

Pub Date 72

Note--49p.

Descriptors--Bibliographic Citations, *Energy, Environmental Education, Health Education, *Publications, *Public Health, *Radiation, Reference Materials, *Safety, Science Education

"Nuclear Energy and the Environment" is a pocket folder of removable leaflets concerned with two major topics: Nuclear Energy and Nuclear Techniques. Under Nuclear Energy, leaflets concerning the topics of "Radiation--A Fact of Life," "The Impact of a Fact: 1963 Test Ban Treaty," "Energy Needs and Nuclear Power," "Power Reactor Safety," "Transport," and "Waste Management" will be found. Leaflets concerning the topics of "In Air," "In Water," "Agricultural Resources," "In Medicine," and "In the Future" are included under Nuclear Techniques. A list of International Atomic Energy Agency Publications on nuclear energy, the environment, and pollution is also included.

- ED 070 649

The Environmental and Ecological Forum 1970-1971

Atomic Energy Commission, Washington, D. C., Office of Information Services.

Pub Date June 72

Note--196p.; Papers presented in the 1970-1971 Environmental and Ecological Forum Series

Available from--National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151 (TID-25857, $3.00)

Descriptors--Conference Reports, *Ecology, *Energy, Environment, *Kinetics, Nuclear Physics, Production Techniques, Public Affairs Education, Radiation Effects, Socioeconomic Influences, *Speeches, *Technology

This report contains the papers presented in the 1970-1971 Environmental and Ecological Forum series, planned to provide an overview of the significant environmental, social, and economic aspects of electric power generation, more specifically, the pros and cons of nuclear power production. The Forum was organized as a public service to foster community understanding of environmental problems that increasingly tax society's capabilities for remedial action. Speakers with widely divergent opinions discussed the various ways in which the increasing development and use of technology may affect man's well-being. Their presentations were titled: Man's Conquest of Energy: Its Ecological and Human Consequences; The Nucs: Energy vs. the Environment; Nuclear Power Plants: Present, Past, and Future; The Radiation Hazard for Man; A Proposal for a Rational Policy to Control Radioactivity and Other Forms of Pollution; The Public and Radiation from Nuclear Power Plants; Adequacy of Present Radiation Standards; The Nuclear Power Information Communication Predicament; Nuclear Power Licensing: Risk--Benefit Determinations and the Public Interest; Nuclear Power; You Never Had It So Good; Benefits and Costs of Nuclear Power; and What We Do Know About Low-Level Radiation.

National Council for the Social Studies

Person to Contact: T. Marcus Gillespie
Associate Secretary

Address: 1201 16th Street, N.W.
Washington, D. C. 20036

Telephone: (202) 833-4476

Materials: Guide to Reading for Social Studies Teachers. Jonathan C. McLendon, Editor, et. al. Bulletin 46. $3.75. "This Guide is intended to help social studies educators find their way into what they need and want to pursue. The [Guide] is organized by sections and topics of the sort that social studies educators are likely to explore." In Part Two of the Guide, teachers will find bibliographical references to "Environmental Problems and Conservation" and "Social Problems, Social Planning, and Change," in planning a unit on the energy problem.

Public Affairs Committee

Person to Contact: None--Write c/o Public Affairs Committee, Inc.

Address: 381 Park Avenue, South
New York, New York 10016

Materials: Cleansing Our Waters
The Campaign for Cleaner Air
An Environment Fit for People
Social Policy--Improving the Human Condition
Noise--The Third Pollution

One to three copies are 35¢ each. Additional quantities can be ordered at a reduced rate. These and other Public Affairs pamphlets are published by the Public Affairs Committee, Inc. and is a non-profit educational organization whose purpose is "to develop new techniques to educate the American public on vital economic and social problems and to issue concise and interesting pamphlets dealing with such problems."

Social Science Education Consortium

Person to Contact: Irving Morrissett

Address: Social Science Education Consortium
855 Broadway
Boulder, Colorado 80302

Telephone: (303) 443-2211

Materials: User's Guide to the Environmental Problem. Free of charge to persons requesting it. This "User's Guide" contains a variety of lessons covering a number of subject areas in the curriculum and grade levels. The procedures of each activity are specifically defined so that with the publication, The Environmental Problem, and any other additional materials, a teacher can easily organize a lesson on "Monday morning." The lessons include many different teaching strategies which incorporate the ideas embodied in the new social studies... On the basis of suggestions in the User's Guide, teachers may also wish to create their own student projects, for which the information in The Environmental Problem can be of value.

The Environmental Problem: Selections from Hearings on the Environmental Education Act of 1970. Edited by Irving Morrissett and Karen B. Wiley. SSEC Publication No. 140.

$[illegible].95. This publication and the "User's Guide" listed above are intended to help students, teachers, and study groups investigate the many facets of environmental concern (e.g. "the energy crisis").

Social Studies Curriculum Data Book (CMAS). The "Data Book" provides an analyses of "project materials, textual materials, and games and simulations. The "Data Book" is offered in loose-leaf form on a subscription basis. New and revised analyses will appear twice a year.

No. 139 (1971-) Data Book in loose-leaf form including all Supplements to date of order and an attractive, durable vinyl-covered 3-ring binder, $20.00
Note: Beginning with the October 1972 Supplement, the Data Book will be divided into two volumes. At this time the price for the above will become $26.00 and will include all Supplements to date, including October 1972 and an additional 3-ring binder for Volume 2.

No. 139-A -- A Data Book and next semi-annual Supplement (includes an additional 3-ring binder for Volume 2), $32.00

No. 139-B -- Data Book and next two semi-annual Supplements (includes an additional 3-ring binder for Volume 2), $38.00

Future Supplements purchased separately when ready, $7.50

Additional 3-ring binder for Volume 2 purchased separately, $7.50

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AN EXAMPLE OF A DATA SHEET TAKEN FROM THE DATA BOOK
(Games and Simulation Section)

Developer: John Wesley

Publisher: Interact Company
Box 262
Lakeside, California 92040

Publication Date: 1971

Availability: From publisher

Grade Level: 4-6 (7-10)

Subject Area: Interdisciplinary
Economics, Environmental Education, History, Political Science, and Sociology

Number of Players: 18-35

Curriculum Areas Analyzed:
Overview
Materials and Cost
Required or Suggested Time
Intended User Characteristics
Rationale and General Objectives
Content
Procedures
Evaluative Comments and Suggestions

United Nations Association of the United States of America, Inc.

Person to Contact: None--Write to the "United Nations Association of the United States of America, Inc."

Address:
833 UN Plaza
New York, New York 10017

Materials: Environment Program Kit. $2.50. Contains up-to-date information on environment versus development, summary of actions taken at the Stockholm Conference, complete text of the "Declaration on Human Environment," other background materials, program suggestions and resource information.

Message from Stockholm. 25¢ single copy. 12 panel leaflet summarizing decisions taken at Stockholm of particular concern to U. S. citizens, a list of background, resources and suggestions for action at local and national levels.

Energy Outlook. Centre for Economic and Social Information. A collection of U. N. reports on the energy outlook compiled by the Centre for Economic and Social Information. Teachers interested in this set of U. N. reports will need to write for cost and materials available at the time of writing. A valuable and up-to-date source material for any unit on the energy crisis.

B. Local Education Agencies

A number of Iowa school districts report having courses in "Environmental Education" and "Man and Environment." Given below is a list of these schools known to be offering a separate and distinct program relating to environmental education. No attempt has been made to identify other courses offered in the schools that may provide elements of environmental education by another course name.

Environmental Education

District Name	Unit Value of Offering
Lisbon Community School	Semester
Garner-Hayfield Community School	Semester
Interstate 35 Community School	Semester
Solon Community School	9 Weeks
Clarinda Community School	1 Year (2 periods long)
Hampton Community School	Semester
Red Oak Community School	Semester
New Hampton Community School	Semester
Saydel Consolidated School	4 - 4½ Weeks
Iowa City Community School	Tri-mester (12 Weeks)
Ottumwa Community School	Semester

Man and Environment

District Name	Unit Value of Offering
Dows Community School	9 Weeks
Earlham Community School	Semester
Springville Community School	Semester
St. Ansgar Community School	Semester
Mount Pleasant Community School	9 Weeks
Spencer Community School	Semester
Iowa City Community School	Tri-mester (12 Weeks)
Newton Community School	Semester
Urbandale Community School	Semester
West Des Moines Community School	Semester

Other Programs

Ecology

District Name	Unit Value of Offering
Belle Plaine Community School	Semester
Urbana Community School	Semester
Newell-Providence Community School	1 Year
West Branch Community School	9 Weeks
Marcus Community School	Semester
Nashua Community School	1 Year

District Name	Unit Value of Offering
Guttenberg Community School	Semester
Mar-Mac Community School	Semester
Camanche Community School	Semester
Ar-We-Va Community School	Semester
Edgewood-Colesburg Community School	Semester
West Delaware County Community School	1 Year
Danville Community School	Semester
Mediapolis Community School	Semester
Valley Community School	Semester
Scranton Community School	Semester
Bellevue Community School	9 Weeks
Colfax Community School	Semester
Iowa City Community School	Tri-mester (12 Weeks)
Solon Community School	9 Weeks
Cedar Rapids Community School	Tri-mester (12 Weeks)
Center Point Consolidated School	1 Year
Central City Community School	1 Year
Albia Community School	Semester
Red Oak Community School	Semester
Muscatine Community School	9 Weeks
Laurens Community School	9 Weeks
Pocahontas Community School	Semester
Bondurant-Farrar Community School	1 Year
Des Moines Independent Community School	1 Year
Saydel Consolidated School	Semester
Southeast Polk Community School	1 Year
Colo Community School	Semester
Norwalk Community School	1 Year

Conservation

District Name	Unit Value of Offering
Iowa City Community School	Semester
Solon Community School	9 Weeks
North Mahaska Community School	Semester
Ankeny Community School	1 Year
Des Moines Independent Community School	Semester
Camanche Community School	Semester
Maquoketa Valley Community School	1 Year
North Winneshiek Community School	Semester

C. A Prototype Lesson: Elementary Level

The Energy Crisis:
An Elementary School Lesson*

Young children are becoming increasingly aware of the national concern about the condition of our environment. It is appropriate that they too be given the opportunity and encouragement to explore some ecological questions and how these questions relate to their own lives. One problem often in the news is the energy shortage, particularly electrical power. As this problem directly affects the everyday living of most children, it is a good basis for classroom investigation. The following activity provides one framework for this type of investigation.

Lesson Objectives

The general objective of this activity is to increase the child's level of understanding with respect to the use and conservation of energy. Specifically, when the lesson is completed the student should be able to:

1. Demonstrate knowledge of how the consumption of energy affects his life and the life of his family.

2. Express an awareness and a concern for the energy problem as it relates to the limited supply of fossil fuels.

Conducting the Lesson

As background for this lesson, the teacher should:

1. Read the testimony of Mr. John Conway, Executive Assistant to the Chairman of the Board, Consolidated Edison Company of New York, Inc., The Environmental Problem, pages 143-48. Mr. Conway discusses the conflict between producing enough electricity to meet public demands while reducing the negative effects of this production on the environment. He responds to the questions regarding advertising the use of electricity and the responsibility of the electrical companies to urge the conservation of energy. In addition, he makes suggestions on how citizens can begin to conserve electrical energy in their homes.

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*Irving Morrissett and Karen B. Wiley (editors). The User's Guide for The Environmental Problem. Boulder, Colorado: Social Science Education Consortium, Inc., 1974.

2. Read the passage beginning in the last paragraph of column 1, page 20, in which Representative Scheuer comments on electrical power and the effect of its production on the environment.

3. Collect newspaper stories, magazine articles, and advertising on the use of electrical power; power shortages; blackouts; and the conservation of energy.

At this point, children may become involved in a number of activities, depending on available time and inclination:

- Chart the amount of time individual lights or appliances are turned on at home or at school.
- Visit a power plant.
- Interview people from the power company about needs and uses of power in the community. Some charting could be done concerning energy prices--i.e., the increasing costs over the last number of years.
- Investigate, through the local power plant or Chamber of Commerce, what the community is doing to save energy.
- Keep individual scrapbooks of clippings from newspapers and magazines about the energy problem.
- Monitor radio and television commercials on conserving electricity.
- Chart home items which, if used less frequently, would conserve power. Perhaps launch a home program--for example, "Save a Watt."
- Make posters to help educate the community about saving electrical power.

The teacher can easily expand this lesson into other areas, such as What is Electrical Power?, How Does an Electrical Power Plant Work?, or What is Our Source of Power?

NOTE: An "affective objective" and/or activity paralleling the "objectives and activities" of the above lesson were developed by Ms. Mary Hays, Drug and Alcohol Program Associate, Curriculum Division, Iowa Department of Public Instruction.

Lesson Objective

A pupil participating in an affective learning activity will be able to identify his own uses of energy and the importance of these energy uses to him.

Activity

Participate in a value clarifying experience, such as "rank orders" or "value continuums" in deciding on an energy-saving change in the household.

NOTE TO THE TEACHER: Definition, procedure for and examples of other "rank order" and "values continuum" are given in Values Clarification, Sidney Simon, et. al., Hart Publishing Company, Inc., New York, C1972, 307 pp., $3.95, AND Clarifying Values through Subject Matter, Sidney Simon, et. al., Winston Press, Inc., Minneapolis, Minnesota, 1973, 144 pp.

- For example, a "rank order" activity might include the following:

  Your family is deciding on an energy-saving change in your household. Which would you vote for?

  - Limit T.V. time
  - Lowered heat
  - Sell dishwasher

  Note to teacher: To effectively develop this "rank order" activity, the teacher should see Simon's, Values Clarification booklet, pp. 58-93.

- For example, a "Values Continuum" activity one might include the following:

  - Your use of electric lights?

Sleeps with entire house lit--Lightbulb Larry	Uses candles only when necessary--Dora Darkness

Note to teacher: To develop this "Values Continuum" activity effectively, the teacher should see "Strategy #8," pp. 116-126, in Simon's, Values Clarification.

D. A Prototype Lesson: Elementary Level

Save Our Environment:
A Contemporary Morality Play*

A morality play is an effective method to present ideas in their least complex form. Here is how one might work, using the materials in The Environmental Problem. This particular play is geared for a middle school audience. With this play as a model, however, older children could write their own scripts, while an even more simplistic approach could be taken with younger children.

Scenario

The narrator enters. He sets the scene by speaking the lines on page 17 of the book, right-hand column, second and third paragraphs.

NARRATOR: "The signs of environmental decay are obvious everywhere. Oil from faulty drillings..."

Each of the following characters, dressed in appropriate costumes, appears in succession. Until now they have been hidden from the audience. Water Pollution is wrapped in oil-stained blue crepe paper, to which beer and coke cans have been tied. Air Pollution is surrounded by black clouds cut out of cardboard and suspended from coat hangers attached to all parts of his body. Solid Waste Pollution should devise a costume resembling a junk heap. Noise Pollution is represented by five people, dressed in street clothing, carrying as many different types of noise makers as possible: horns, sirens, clanging pieces of metal, drums, cymbals, tambourines, etc.

As each character appears, he gives a short speech describing his particular plight and then retires to the back of the stage. Statements should be taken from newspaper, magazine, and television news stories and other appropriate sources. Each speech should be presented mournfully. After all the Pollutants have appeared, the narrator makes a speech about how we can solve our pollution problem.

General Solution, Value Solution, Education Solution, and Government Solution then run onto the stage. Dressed in white, they line up and each gives a short speech, based on selections in The Environmental Problem. Material for General Solution is on pages 19 and 48; for Value Solution, pages 91, 92, and 172; for Education Solution, pages 34, 39, 40, and 170D; and for Government Solution, pages 60, 136, and 137.

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*Morrissett and Wiley, op. cit.

The Solutions then turn to the Pollutants and try to reach out to help. The Pollutants scream for help; the Solutions shout that they wish they could help, but there is no way because of lack of understanding and money.

The Narrator appears and presents a short speech in which he summarizes the congressional testimony that called for public and private funds, as well as public understanding and cooperation, to implement solutions. He then rushes off stage and brings on a wagon full of large cardboard pieces representing money, public understanding, and cooperation. He distributes these cards to the audience and says, "If you want to help, give your cards to the Solutions and return to your seats."

When the Solutions get the cards, they huddle together, chatter, shout, and jump around. Pollutants, which have quieted down now, come back to life and again ask for help. Solutions run to them and in slow motion start to remove their exterior costumes to reveal white garments underneath. All dance and shout for joy.

Curtain.

E. Complementary Activities. Given below are a set of learning activities and objectives developed originally by the Washington Superintendent of Public Instruction and the Public Power Council. "One of the results of this pioneering union between the educational and business community has been the development of ENERGY & MAN'S ENVIRONMENT ACTIVITY GUIDE.* It is from this guide that a representative group of activities and objectives are provided for your utilization. Each of the six chapters contain four major themes for purposes of "insuring easy adoption for any subject." The themes are: Scientific, Ethical, Aesthetic, and Utilitarian. For our purposes, we will select from only those objectives and activities of the "Ethical theme."

Six chapters comprise the ACTIVITY GUIDE. These being:

Chapter 1. *USES OF ENERGY*
Chapter 2. *SOURCES OF ENERGY*
Chapter 3. *CONVERSION OF ENERGY*
Chapter 4. *ENVIRONMENTAL IMPACT OF ENERGY SOURCES AND USES*
Chapter 5. *LIMITS OF THE EARTH*
Chapter 6. *FUTURE ENERGY SOURCES*

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*Energy and Man's Environment: Activity Guide. Second Revised Discussion Draft. Thomas F. Ris, editor. Washington: Office of Environmental Program, The Washington State Superintendent of Public Instruction in cooperation with The Oregon State Department of Education and The Idaho Department of Education, 1973. (For more information contact: Energy and Man's Environment, 2121 Fifth Avenue, Seattle, Washington 98121.

USES OF ENERGY

Primary Grades

1. The student will state at least three advantages and disadvantages of using each of the following electric appliances:

    - toothbrush
    - toaster
    - hot water heater
    - freezer
    - lights - incandescent and fluorescent
    - space heating
    - air conditioning
    - radio
    - television
    - range
    - dishwasher
    - rotisserie
    - "radar" range (microwave oven)

    The student will list the electrical appliances in his home in the order of their importance. List separately the ones he feels could be eliminated without lowering his "quality of existence."

2. The student will list five different electric appliances used in his home that the family could most easily live without. He will state reasons for each decision and describe what effect this would have on his family.

    The student will write a letter to the manufacturer of one of the electrical appliances found in his home, asking for information about the source of the materials used in its manufacture.

Intermediate

1. The student will find out what regulations exist in his state concerning the use of snowmobiles, trail bikes and/or sand dune vehicles. Discuss in class whether or not the use of these vehicles can be justified on the basis of their energy use and environmental impact. Write an essay exploring and sup[illegible]ing a position for or against using one of these vehicles.

    The student will describe the impact of recreational vehicles on the environment. Include the family automobile when used for recreation.

2. The student will list all the "energy users" that he personally owns or uses, such as radios, toys, appliances, etc. In the list, state the type of energy required, [for] such as AC power battery, wind-up spring, etc. After completing the list, compare it with the items a student might own in a nation which uses less energy such as India. Try to list the "energy users" the Indian child might use.

The student will compare the lifestyle of an underdeveloped society with his lifestyle. He will consider the energy consumed, and discuss the difference.

SOURCES OF ENERGY

Intermediate Grades

1. The student will list the positive and negative considerations surrounding the industrial, commercial and residential use of energy (coal, oil, gas, wood, nuclear) in terms of:

   - pollution
     (1) air
     (2) water
     (3) radiation
     (4) visual (plant, fuel storage, etc.)
   - location
   - impact on people
   - economic impact
   - mining
   - processing
   - transportation

   Set squares of white paper inside and outside a house, inside and outside a school, near a manufacturing plant, and in the downtown area. Each for a 24-hour period. Compare the findings.

2. The student will describe desirable limitations of individual energy use. How does individual use of energy affect others? If he stopped using energy, how would that affect others?

   The student will describe changes in his family's activity for an average day if they had no automobile.

CONVERSION OF ENERGY

Intermediate Grades

1. The student will construct a set of guidelines for the use of rapidly diminishing sources of energy (i.e., should fossil-energy resources be used to depletion as a fuel source?)

   To conserve gasoline, a decision has been made to reduce the number of automobiles in this country. The student will draft a set of priorities and regulations to accomplish this as fairly as possible for all citizens.

ENVIRONMENTAL IMPACT OF ENERGY SOURCES AND USES

Intermediate

1. The student will compare at least three of the advantages and disadvantages, in terms of pollution, of home heating with oil, natural gas and electricity.

   The student will pretend that a major disaster has hit the community. Sources of electric power and water have been damaged. Describe the activities of the student's family under these circumstances. Underline each activity that is normally performed by power e.g., chopping and burning wood for heat, purifying water, etc.

2. The student will describe six things he can do to reduce the need for additional energy in his life.

   The student will study some magazine advertisements about energy and power. Then formulate advertisements that reflect the point of view of the:

   - power producer
   - environmentalist
   - old mother earth
   - manufacturers' association that asks for a personal commitment by citizens to reduce the need for additional energy in his life

   Present the advertisements to the class or PTA and ask for reactions from the audience.

LIMITS OF THE EARTH

Intermediate

1. The student will describe the relationship between limited energy resources and international trade.
2. The student will describe the relationship of limited energy resources to social systems such as political, economic, and family.
3. The student will evaluate what is necessary to implement a policy based on unlimited energy.

FUTURE ENERGY SOURCES

Intermediate

1. The student will describe the voters' responsibility to require systematic and practical municipal planning to utilize sewage and garbage for the most appropriate limiting of pollution and recycling of minerals, materials and energy.

The student will describe the relationship between the local garbage disposal unit and the local government.

Describe the disposal methods of solid waste in the community.

Investigate alternative methods of waste disposal which have less negative environmental impact.

F. A Prototype Mini-Course

A 3-4 Week Mini-Course[*]

A simulated Congressional hearing is one of several activities that is appropriate for classroom study of environmental issues. The public hearing format is especially useful in encouraging student interest and involvement. The hearings on the Environmental Education Act of 1970 in The Environmental Problem provide the necessary information around which the following simulation can be organized.

Materials

1. A classroom set of The Environmental Problem.
2. One or more general films on environmental problems.
3. Basic teaching supplies.

Activities Schedule

1. Review environmental problems--one day.
2. Research environmental issues--three days.
3. Draft environmental education bill--three days.
4. Prepare testimony--three days.
5. Conduct hearings--five days.
6. Construct final education bill and community action program--two days.
7. Activity review and examination--two days.

This schedule is only a recommended guide. Teacher modification would allow for meeting particular school and community needs.

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[*] Morrissett and Wiley, op. cit.

Rationale

Few Americans understand the government hearing process which is designed to gather, question, challenge, and summarize information. These hearings form the basis from which Congressmen determine their views for drafting legislation. While a research lesson in environmental problems, this activity provides the opportunity to participate in a government operation. Students will utilize an edited government document as they learn to survey, research, summarize, and apply information from the actual hearings which led to the Environmental Education Act of 1970. A careful study of the hearings will allow students to evaluate the nature of this government procedure and the implications of the resulting law.

Objectives

After participating in the environmental hearing simulation, students will be able to:

1. Better understand the range of opinion on environmental issues.

2. Present a position, utilizing the skills of summary and analysis in a role-playing situation.

3. Apply acquired information to construct an environmental education bill.

4. Evaluate community activities which affect environmental problems, and consider alternative measures.

5. Review a Federal law as it emerges from Congressional hearings and evaluate its implications.

6. Better understand that the creation of government policy is ultimately dependent upon citizen concern, communication, ideas, and public awareness.

(7. Examine individual life-styles associated with the legislation drafted and identify need for changes in personal behavior. --- Iowa Department of Public Instruction)

Procedure

The basic teaching strategy is a simulated Congressional hearing and the accompanying role-playing activities. After an initial inquiry into environmental conditions, the class forms special interest groups to draft an environmental education bill. The proposals of the class's bill are then presented in the hearing format where students assume the roles of examiners, witnesses, and so on. When all the testimony has been heard, a student committee considers the class's proposals, making appropriate changes and modifications to construct a viable education bill, on which the students then vote.

Step One: Have students list the basic environmental problems and present views on what has been done to solve these problems and what still needs doing. At this point a film would be useful to review the scope of the environmental issue.

Useful sample issues include: our environmental quality has worsened in the last three years; the energy crisis has been exaggerated; and the environmental concern is a short-lived fad.

Step Two: Organize the students into special interest groups to research issues in The Environmental Problem. Suggested topics include: Population; Air, Water, and Noise Pollution; Use of Natural Resources; and Energy and the Environment.

Step Three: On the basis of their research, each group writes a proposal for the draft of the class's education bill. Students should refer to the provisions of the Environmental Education Act of 1970.

Step Four: Assuming roles similar to those found in the actual hearings, students prepare to testify on their bill proposals by studying appropriate positions, finding supportive outside materials, and engaging in group discussions.

For example, the hearing on the topic of air pollution would include at least two witnesses: one to testify that present standards and practices are inadequate, and one to refute this testimony. An alternative approach to the same issue is to have students role play various persons such as an educator, a conservationist, an architect, a theologian, or an engineer, and give testimony. In both situations, students consult The Environmental Problem for source material.

Step Five: Students conduct hearings. Witnesses are called to testify, presenting their views to a panel of examiners. When all the testimony has been heard, one day is set aside to review the issues so that positions are clearly understood and conflicting ideas highlighted.

Step Six: A student committee studies the class's proposed legislation in light of the hearings. Using the Environmental Education Act of 1970 as a model, the committee constructs the Environmental Education Act of 19__. At this time the rest of the students work on a program to increase community awareness of environmental problems.

Step Seven: The student committee presents the final bill to the class for approval.

Step Eight: The hearing process is reviewed in the context of the class's action. Copies of the final bill could be sent to your Congressman and selected Congressional committee members.

(Step Nine: Convert the list of basic environmental problems (Step One) to specific resources or energy forms. Under each, list things in their life in the last week associated with or using the environmental factor.

Apply the legislation drafted to determine if their behavior will continue, increase, decrease or change and the consequences of that behavior.

Prepare a letter to Congressman or media personally supporting or rejecting proposed legislation in line with their own daily behavior.

Small group discussions of results in above activities and behavior change and how they feel about that. --- Iowa Department Public Instruction)

Evaluation

The effectiveness of the hearing activities can be evaluated by a "before and after" examination of your students which surveys their understanding of:

1. The nature and seriousness of the environmental problems.

2. Possible solutions to these problems.

3. The role of the Congressional hearing as a public forum to gather information.

Follow-up Activities

Community surveys, school meetings on local environmental conditions, outdoor projects to develop an environmental laboratory, and long-term projects to monitor conditions are all appropriate follow-up activities. The students might also hold a citizens' meeting to present their findings and suggestions for improvement.

(Follow-Up---Sometime later, 1 month to 6 months. Small group review of each person's proposed behavior, action taken and present feeling. --- Iowa Department of Public Instruction)

G. A Value Clarification Activity*

Value conflicts are often the obstacle to solving environmental questions: population should be controlled, but--it is against God's law to control birth. The automobile is one of the greatest air polluters, but--the automobile is one of the most convenient forms of transportation. These opposing statements which appear in the testimony on the Environmental Education Act of 1970, as well as many other value conflicts, are evident throughout The Environmental Problem. From the information in this book, the following value clarification activities based on a system of analysis devised at Harvard (see U.S.O.E. Final Report #HS-058, and #OE-3-10-142; ERIC document SO 001 706) can be developed for secondary and college level students.

Objectives

With the completion of this activity, students should be able to:

1. identify major environmental issues facing the nation.

2. use a specific set of analytical tools to clarify these issues in order to make rational policy decisions.

3. make rational value judgments on the basis of analysis.

4. recognize faulty analysis and alter a position accordingly.

Procedures

Have the students read selected sections from The Environmental Problem which suggest policy questions, i.e., questions that involve some form of action. For example, Commissioner of Education, James Allen, states that the United States Office of Education must lead the schools into the development of environmental education programs (page 131ff). Commissioner Allen asks, "Should the Federal government encourage the teaching of a particular course or content in the local schools?"

In order for students to answer a policy statement such as this one, they should be made aware of the three types of issues that need clarification before a decision can be made. These are:

1. issues of fact and explanation.

2. issues of definition.

3. issues of a moral-value nature.

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*Morrissett and Wiley, op. cit.

An issue of fact (factual claim) is a statement of what is, not what ought to be or what will be in the future. In the case of Commissioner Allen's question, the issue of fact is the already existing courses in environmental education being taught in the nation's schools.

An issue of definition is the key to the whole clarification procedure. Each word in the policy statement must be clearly defined within the context of the specific problem. For instance, what does "environmental" include? Is a biology course part of an environmental education program?

An issue of morality is obviously the most difficult to consider because it is a statement of judgment. It should therefore be supported by general principles rather than by law, rule, custom, or personal preference. A value-laden statement like, "It is bad for the Federal government to interfere with local education," cannot be defended without first returning to a more basic principle, such as "A government which governs least governs best."

When these three issue areas have been thoroughly discussed, the students should then select a number of policy questions to be written on the chalkboard.

Useful examples, taken from The Environmental Problem, are:

1. the production of electric power, either from fossil fuels or atomic energy, has a negative impact on the environment; but products such as electric toothbrushes, meatcutters, and hairbrushes are essential household items (pages 145-46).

   Policy Question: Should the Federal government ban the production of these products?

2. Controls must be placed on the individual because everyone is responsible for some form of pollution; but our system of government guarantees the individual rights and privacy of citizens (page 144, especially the last half of the second column).

   Policy Question: Should pollution control laws go beyond industry, into the home?

3. Unchecked materials growth and expansion has resulted in environmental exploitation and destruction; but growth is necessary for a vibrant economy--a nation grows or it dies (the last half of the second column on page 4 and all of page 22).

   Policy Question: Should the government place restrictions on the growth of private enterprise?

4. Sophisticated technology causes detrimental side effects on the quality of the environment; but social and material needs cannot be met without continued technological development (page 7, "The Complexity of Environmental Solutions").

> Policy Question: Should the government continue to fund mostly technologically-oriented projects, or should research money be directed toward studies of the more "natural" uses of the environment?

Once the issues have been chosen and posted, assign a team of students to each policy question. Within each team, students will choose a position, using The Environmental Problem to research facts, clarify definitions, and support moral or value assertions.

After the issues have been examined according to the suggested criteria, a poll might be taken to determine how many students, if any, have altered their position because of this analytical approach.

H. Complementary Activities. Given below are a set of learning activities and objectives developed originally by the Washington Superintendent of Public Instruction and the Public Power Council. "One of the results of this pioneering union between the educational and business community has been the development of ENERGY & MAN'S ENVIRONMENT ACTIVITY GUIDE.* It is from this guide that a representative group of activities and objectives are provided for your utilization. Each of the six chapters contain four major themes for purposes of "insuring easy adoption for any subject." The themes are: Scientific, Ethical, Aesthetic, and Utilitarian. For our purposes, we will select from only those objectives and activities of the "Ethical theme."

Six chapters comprise the ACTIVITY GUIDE. These being:

Chapter 1. *USES OF ENERGY*
Chapter 2. *SOURCES OF ENERGY*
Chapter 3. *CONVERSION OF ENERGY*
Chapter 4. *ENVIRONMENTAL IMPACT OF ENERGY SOURCES AND USES*
Chapter 5. *LIMITS OF THE EARTH*
Chapter 6. *FUTURE ENERGY SOURCES*

USES OF ENERGY

Middle and Junior High

1. The student will describe the impact of recreational vehicles on the environment. Include the family automobile when used for recreation.

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*Ris (editor), op. cit.

2. The student will discuss "trade offs" which must be considered before constructing the following:

   - a geothermal generating plant
   - a nuclear generating plant
   - a hydroelectric generating plant
   - a fossil fuel generating plant

   The student will list in descending order the amount of radiation naturally occurring in his area; the amount resulting from dental x-rays; the amount resulting from arm or leg bone x-rays; the amount given off by the nearest nuclear power plant per day; the amount used in radiation treatment of cancer. Also consider cosmic Ray Fleet, radioactivity in rock, luminous watch dials. Discuss results. NOTE: Local health department; local dentists, local hospital will be sources.

Secondary and Senior High

1. The student will describe common food and toiletry packages and containers, listing energy sources required to produce them.

   The student will calculate the energy required to move his body weight one mile by walking; contrast with energy required to move one mile by bicycle; one mile by automobile. (Include the energy required to manufacture the vehicle.)

2. The student will discuss the political implications of the energy-use imbalance in the world today.

CONVERSION OF ENERGY

Middle and Junior High

1. The student will enumerate the ethical implications of one social group using 25 times as much of an unrenewable resource than another social group.

   Should limitations be placed on uses of energy, land and natural and processed resources? What should those limitations be? What type of agency should have that regulatory power?

2. The student will list the ethical and practical considerations to be made when disposing of energy conversion wastes.

   Three elements of the "good life" are:

   - desirability of work and school environments
   - desirability of home environment
   - desirability of recreational environment

a. The student will list all energy-consuming devices needed for each environment and for transportation to each environment.
b. Describe the location in terms of the most desirable climate, landscape and population.
c. If a model city were to be built, locate it on a map. Could energy be transferred there, reasonably, from present sources?

ENVIRONMENTAL IMPACT OF ENERGY SOURCES AND USES

Middle and Junior High

1. The student will define the rights of each individual to power resources.

Simulation Game: Design a court case.

An underdeveloped nation sends a boy from a primitive tribe to ask the world court for his share of the world's energy.

Participants:

a. Judge
b. Boy from underdeveloped nation
c. Witnesses
    (1) United Nations representative
    (2) U. S. Department of Public Health
    (3) Mother of boy from U. S.
    (4) Mother of boy from underdeveloped nation
d. Lawyers (2)
e. Jury (5-man)
f. Defendant (boy from U. S.)

Be sure to include descriptions and quantify the natural resources involved in providing energy for the American boy. And be sure to note ways in which he consumes energy which are not obvious.

Secondary and Senior High

1. The student will describe appropriate recycling laws.

LIMITS OF THE EARTH

Middle and Junior High

1. The student will discuss the ethics of a group or individual that monopolizes a disproportionate share of a resource.

The student will contrast the immediate and long-term effects on the people of Saudi Arabia and Kuwait by the discovery and exploitation of oil in their countries.

Secondary and Senior High

1. The student will give examples of the loss of freedom in our legal system as constraints are placed on energy use.

FUTURE ENERGY SOURCES

Middle and Junior High

1. The student will describe responsibilities to conserve power through lifestyles which respect the needs of other persons. What must be changed? Can the changes be effected?

Secondary and Senior High

1. The student will describe the processes and organizations which would support basic scientific research and applied technological research regarding a better use of energy resources.

   The student will list those organizations in the state involved in scientific research. Find one piece of research one of these organizations has completed.

REQUEST RETRIEVAL FORM

Instructions: Use this "Request Retrieval Form" for ordering your complete microfiche document from among the "Document Resumés," pp. 29-36.

Fill out the information asked for below and send to:

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Department of Public Instruction
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PART III

POSSIBLE CLASSROOM ACTIVITIES

PART III

POSSIBLE CLASSROOM ACTIVITIES

AN ELEMENTARY UNIT

Rationale: The elementary age child is frequently subjected to words that are in common usage, but nebulous to his understanding. Energy is such a term frequently used in our present-day language, but difficult for the young mind to comprehend.

The following suggested unit is designed for elementary grades 3, 4, or 5. It may be adapted for use in grades K, 1, 2 and 6 according to the teacher's discretion. It is intended to provide the young student with a better understanding of what energy is, to develop an appreciation of its two basic forms of energy (stored energy and energy in motion), to develop a better comprehension of the primary sources of energy, and to develop an attitude for a conservation ethic relating to energy.

Modeled after an elementary grade slide presentation prepared by Mrs. Harriette Lindberg of Des Moines for Iowa Power and Light Company, the unit was developed by three curriculum consultants from the energy project committee.

The following model was used to develop the total unit as well as each individual concept within the total unit structure. The material may be used as a separate unit or portions of the unit may be adapted into existing curriculum. It is suggested that the teacher read the entire unit in advance in order to provide for experimental materials when needed.

CONCEPT

STUDENT LEARNING OUTCOME*

LEARNING EXPERIENCES

SUGGESTED QUESTIONS | EXPERIMENTS | DEMONSTRATIONS | ACTIVITIES

CLOSURE**

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*Student Learning Outcome: The student learning outcome states what the student is expected to learn as a result of going through the learning experiences.

**Closure: Closure should answer the question: Did the student learn the original concept as a result of going through the learning experiences?

A BUNDLE OF ENERGY

A. Concept: *How energy is used to do work.*

Student Learning Outcome: The student will be able to verbally define energy and give examples by body movements.

Learning Experiences:

ENERGY! You have heard a lot about it. You have been told to conserve energy, but what is energy? Where does it come from? Why do we need energy? Is it a mysterious force that comes to us from some unknown place? Do you have some ideas about what energy is or where it comes from?

Let's think about some things energy might or might not be. Could it be an apple on a tree? Could it be a chunk of coal? Is it a television set? How about a field of Iowa corn? It will be fun to explore some of these possibilities and experiment with them to see if they are energy!

An apple on the tree might fall from the tree and hit the ground. Do you suppose energy was needed when this happened? If the apple is red and pretty you might be tempted to pick it up and eat it. That is, of course, if the tree were in your yard. If you ate the apple would it then be energy?

If you skip around the room you would need energy. When your body moves, you need energy. When the wind blows, water runs down hill, or when a fire burns energy is required. But what is energy? Energy is the ability to do work.

Suggested Questions:

1. What allows you to run and skip?
2. Where do you get the energy to run and skip? (Possible expected answer would be food.)
3. What do you think energy might be?
4. Can you give some examples of energy?

Note: Number 122 in the bibliography may be helpful.

B. Concept: *How useable energy is received from the sun.*

Student Learning Outcome: The student will be able to tell (verbally) where energy comes from.

Learning Experiences:

Where does energy come from? We are able to move our arms and legs, we can wiggle our fingers and toes and we can hop and skip. But how can the parts of our body move? Is it because of energy? If it is because of energy, where do we get the energy to move? Just where does energy come from?

Was it in the food you ate--the apple, the corn on the cob, or the meat and potatoes? Yes, there was energy in those good things to eat, but is that really where the energy chain started? It may still seem to be a mystery, but mysteries are fun and if you continue reading you will soon learn the answer!

A field of corn has energy? It is eaten by cows, pigs, or boys and girls. They seem to like it best on the cob! Do you? Food is used by our bodies to allow us to move, think and play games. All these activities require a lot of energy. Does the energy for these activities come from the ground, the air or maybe someplace else?

We have lots of questions about energy and where it comes from, but our answer will be found in the form of something very familiar and very old--yes, even older than the earth! It greets us every morning in the east and bids us good night each evening in the west. By now have you guessed what that old familiar thing is? That's right, it is the sun!

Most of our energy comes to us in the form of light from the sun. We know the sun helps to warm most days. It is responsible for the winds that blow, for the apple hanging on the tree, a field of corn, and even coal, oil and natural gas.

Suggested Questions:

1. Do you have some ideas how we get energy from the sun?
2. Who has some ideas about the kind of food the sun's energy makes? (The desired final answer the teacher may need to provide will be simple sugar.)

Demonstrations:

1. Use a magnifying glass to allow the sun's rays to be focused upon a piece of paper. (Note: A stand may be necessary to maintain the magnifying glass the proper distance from the paper and in a steady position.) The paper should catch fire or turn brown after several seconds if the magnifying glass is the proper distance from the paper.
2. If a solar energy demonstration kit is available in your school, allow the direct rays of the sun to strike the cells and to demonstrate its effectiveness in converting light

energy to electricity and then to mechanical energy. (A solar energy demonstration kit is a kit that may be available in your science department. The science teacher will be of help to you in ordering such a kit if the district does not have one.)

Activities:

1. Have the students place pans of water in sunlight and shaded areas. Compare the temperature difference of pans of water placed in direct sunlight to those placed in the shaded areas of the room for a period of time.

2. Winter activity: The students will take a mini-field trip in the schoolyard. They will make notations of snow accumulations with respect to snow depths, quantity, evidence of melting and bare spots on the schoolyard. In particular compare the snow on the south and north sides of the school building.

3. Spring or fall activity: The students will observe the types of plants found on the north side of the school building. Compare these types of plants with those found on the south side of the building. Also, have students make temperature comparisons between the north and south sides of the building.

Note: Numbers 121 and 122 in the bibliography may be helpful.

C. Concept: *Energy changes form through photosynthesis.*

Student Learning Outcome: As a result of going through the learning experiences the student will be able to explain how the green plant converts energy from the sun (sunlight) into food.

Learning Experiences:

The rays of the sun warm our earth. The sun provides us with daylight and you know that it provides us with warm sunny days in the summer. The sun serves another important purpose to us. It is a purpose that we all depend upon. The sun's light allows the green plant to make sugar and sugar is the first step in the food making process. We can refer to it as the beginning of the food chain. The plant will later change the sugar into starch so it can be stored. This is step two in the food chain.

Like all green plants the leaves on the corn plants in a field of corn are able to change sunlight into stored energy by a process called photosynthesis. Photosynthesis is a most important process. Nothing could live very long without it such as corn, apples, creepy crawly things or boys and girls. Photosynthesis means to make food by using light. That important magical formula (photosynthesis) belongs only to green plants!

Energy is changed from light into food by the green plant. Later an animal may eat the plant like a pig eating corn. The energy simply changes form. The energy in the corn will now become part of the pig who ate it. This energy allows the pig to live, grow and move.

It would be a very strange world without plants and their wonderful formula for changing energy from light into a form which we use in many ways.

Suggested Questions:

1. Who has some ideas about the kinds of food the sun's energy may make? (Discussion should conclude that it is sugar.)

2. How are our bodies dependent on photosynthesis (the process that changes sunlight into stored energy) that occurs in green plants?

3. Who has some ideas how the sun's energy is stored in the green plant? (Note: The teacher may demonstrate at this point to the students that cornstarch is a starch by using the iodine test used in part two of the experiment given below. This shows that energy is stored in the plant in the form of starch.)

4. Can you give some examples of plants we use that store energy in their leaves? Stems? Roots?

Experiment: The presence of starch in a plant can be demonstrated.

Part I.

Materials

1. Two or three medium to large size geranium plants
2. Paper clips
3. Iodine solution (IKI solution should be available from the high school science department. Note: Iodine causes starch to turn black.)
4. Saucers or shallow dishes
5. Forceps (tweezers)
6. Alcohol

Each student will cut a design half the size of a geranium leaf. The designs may be appropriate for the season. (i.e. stars for Christmas, hearts for valentines, shamrock, Easter eggs, etc.) Each students' initialed design will be firmly placed on a selected leaf with paper clips for three or four days. The plant should be placed in a position to receive direct sunlight for this period of time.

The experimental leaves should be removed from the plant the last afternoon. The design should be removed from the leaf and the leaf should be placed into warm to hot alcohol to remove the green color. (Note: If hot alcohol is used the teacher should assist in the process for safety purposes. Alcohol is flammable!) The alcohol should bleach the green color from the leaf where the sugar is concentrated.

The leaf should now be dipped into the iodine solution for approximately one minute. The areas that were covered by the design should turn black (so will fingers, therefore use forceps) due to the reaction of iodine upon the stored starch in the leaf.

Part II.

Materials

1. Dry corn kernels
2. Dry bean seeds
3. Sprouted corn kernels
4. Sprouted bean seeds
5. Paper towels
6. Shallow dishes or margarine dishes
7. Water
8. Iodine solution
9. Forceps
10. Knife

The students can germinate the corn and bean seeds five to six days in advance by placing them on a wet paper towel in a shallow dish. Keep the dish covered in a warm dark place.

The teacher should provide each student with split dormant corn kernels and split dormant bean seeds. The student will place the split seeds in a shallow dish. Cover the seeds with an iodine solution. What reaction did you get?

Repeat the process with a corn kernel and a bean seed that have been allowed to germinate for several days. Was there a difference in the reaction? (Note: The plant stores its energy in the form of starch, but when it needs the energy, such as in the sprouting process, it converts the starch back to sugar.)

Note: Numbers 37 and 122 in the bibliography may be helpful.

D. Concept: *Coal and oil are formed from plant and animal material.*

Student Learning Outcome: The student will be able to identify sedimentary rock and organic material.

Learning Experiences:

What does photosynthesis have to do with oil and coal? Some of you may already have a clue, but let's look for some other hints. The earth is very old. We know this because the earth has left us a book that tells us a lot about itself. It is a most unusual book because it has no words and it is mostly rock. Nevertheless, it tells us an important story. It is sort of like a picture book. Many times rocks are found in layer upon layer. Each layer is like a page of a book. Of course, you must learn a special kind of language to be able to read this book. Wouldn't it be exciting to learn to "read" a new language like this?

The story we find in the rock tells us the kinds of plants and animals that lived many years ago and when they lived. It can also tell us when it was hot or cold as well as when it was dry or wet for long periods of time. We know that some places were covered by water for millions of years. Many plants grew in shallow oceans and seas. The plants were changing the light energy from the sun and storing this energy in their stems, leaves and roots. There were also many animals that fed on the plants or upon each other.

Plants and animals that lived millions of years ago would live and die as they do now. Many of the plants and animals would fall to the bottom of the shallow seas after they died. If air was unable to reach these dead plant and animal parts they would not decay rapidly. On top of these dead plant and animal parts the skeletons of animals and other plants would pile up and form thick layers of organic material. Later these might be covered with mud. As layer upon layer was added, the pile would get heavier and become packed down to form a special substance--sedimentary rock. It takes many, many years to form sedimentary rock.

If conditions were right this special substance would form coal, but at other times oil would be formed. This process is still occurring but it takes many years to complete. It occurs so slowly that hardly any oil or coal has been added to our earth in the past one hundred years.

Suggested Questions:

1. What do you think the plants and animals were like that lived when coal was forming?
2. How might we learn to read the messages left for us in the sedimentary rock?
3. Who has some idea of what a hundred is?
4. Can you show me an example of a hundred?
5. Who has some idea of what a million years might be?

6. Could you go out and count a million of something?

7. What are some of the ways that nature uses to communicate with us? (See activity number four.)

Experiment: A fossil in a rock.

Materials

1. Plaster of paris
2. Plastic leaves (Natural leaves may be used in season)
3. Margarine dishes or milk cartons
4. Vasoline

Place a thin layer of vasoline on both sides of the leaf or leaves to be used. Fill the margarine dish about 1/4 full with the plaster of paris mixture.

Now float the leaf on the plaster of paris mixture. Allow the mixture to set briefly. Coat the entire surface with a layer of vasoline and cover it with an additional layer of plaster of paris. Allow plaster of paris to set up for a few minutes.

Students will remove material from the margarine dish. Break the plaster of paris on the cleavage edge. Remove leaf to demonstrate a fossil imprint in the rock.

Demonstrations:

1. Allow students to examine chunks of coal and break them along their cleavage edge. Examine for imprints of fossil plant remains.

2. The class will develop a time-line to show the following: (a) formations of coal deposits, (b) the age of dinosaurs, (c) the period of development of the Rocky Mountains, (d) the discovery of America, (e) the Declaration of Independence, and (g) the year of the student's birth.

Activities:

1. The students will look through books, magazines, etc. for pictures of plants and animals which relate to suggested question number one.

2. The students will use treasure maps provided by the teacher to help them locate fossil remains in limestone rock. It may be dubbed the "Great Fossil Hunt!" (Note: Many times building materials in the school construction or in nearby building construction sites will utilize fossil limestone.)

3. The students will bring in rock specimens and locate evidence of layering in some forms and examine for possible fossil evidence.

4. Using a tape recorder students will collect nature's sounds found on their schoolyard to demonstrate a method of non-verbal communication. (The message in the rock is also a non-verbal form of communication.)

5. Winter activity: The students will investigate the layering process by examining the cross section of an accumulation of snow. This may be correlated to the layering and weight pressure in rocks.

6. The students will locate pictures of oil and products made from oil. These will be assembled by the class into a collage of their own design.

Note: Numbers 18, 19 and 107 in the bibliography may be helpful.

E. Concept: *Coal and oil are important fossil fuels but are in limited supply.*

Student Learning Outcome: The student will investigate some important prime energy sources and will be able to verbally and visually identify various forms of prime energy sources.

Learning Experiences:

To help you understand why plants and animals that lived long ago are important to us now, it may be helpful for you to know where electricity comes from. We use electricity to turn on our lights, to run mother's vacuum cleaner and washing machine, the television set and to run the red and green traffic lights on the corner.

You have seen wood burning in a campfire. You know that a campfire gives off heat to cook with and keep you warm. Remember that wood was part of a plant. Coal and oil were also once a part of plants, that have long since decayed. We still refer to them as being organic, which means that they once were part of living plants or animals. By burning these fossil fuels (fossil means dug up fuels) we can get heat just like we can get heat from the campfire. By using the heat to change water into steam we can turn machines that produce electricity. Fossil fuel may also be burned in a car to make an engine go.

Our problem is that we have only a certain amount of fossil fuels. Once they are gone there will be no more! We are using our fossil fuels much faster than they can be made. Since they are usually covered with thick layers of dirt and rock, fossil fuels are also difficult to find.

As you know, some apples taste better than others and some are hanging where you can reach them. Also, some forms of coal and oil are better than others and some are not so far below the ground. We have used the good forms first and those that are the easiest to reach. To uncover the deeper layers of coal requires the removal of large amounts of dirt and rock which makes the land look ugly. Deep holes for oil wells are also necessary and oil is becoming more and more difficult to find. These efforts require large amounts of energy.

If we only have a limited amount of coal and oil we must be careful that this supply is not wasted. Coal and oil are necessary as fuels, but we also use them for many other things like clothes, plastics, medicine, toys and a thousand or more things you find useful.

Because of the limited supply we are trying to find other methods of using the sun's energy. Some of these include wind, direct heat (solar energy) from sunlight, and running water. Nuclear energy from the atom and heat from geysers, such as Old Faithful, are sources of energy that we are learning to use. Can you think of others we might add to the list? Why is it important that we use our energy carefully?

Suggested Questions:

1. What do you think might happen if we ran out of oil or coal?
2. If we run out of oil or coal can you imagine what your life would be like?
3. What things in your classroom do you think might be made from coal or oil?
4. Can you provide some suggestions of ways to prevent us from wasting coal and oil?
5. Can someone tell us about Old Faithful?
6. Can you think of some other kinds of energy?

Activities:

1. Using the playground or school neighborhood the student will measure the distance across the playground which is equal to the distance into the earth needed to go to reach coal and oil.
2. The students will develop a list of the appliances that use energy at school and at home. From this list they will make a list of appliances that they use at home and at school. For each list the student will rank the appliances in order of importance.

3. Each student will make observations within the school building or on the schoolyard looking for energy in different forms. Have the students draw a poster illustrating at least one example of what they feel is an energy resource.

Note: Numbers 4, 9, 10, 69, 89, 91, 123 and 11A/V in the bibliography may be helpful.

F. Concept: *Energy has two basic forms--stored energy and energy in motion.*

Student Learning Outcome: The student will be able to distinguish between stored energy and energy in motion.

Learning Experiences:

When you turn on a light you say you are using energy. Energy that was stored in a plant a long time ago! It was much the same as the corn on the cob or that rosy red apple, which as you know all started with energy from the sun. By now you understand that energy is important, but difficult to explain.

Energy is present in two different forms. One is energy in motion. Examples of energy in motion are a fire, electricity, using our muscles, or watching an apple fall from a tree. This is called kinetic energy which is another name for energy in motion.

The other form of energy is stored energy. Coal, oil, wood and food are all examples of stored energy. Water behind a dam can be made to do work in the future and is called stored energy. We can refer to stored energy that will do work in the future as potential energy.

You have learned that energy is the ability to do work. We know that there is energy in the food we eat, and also in oil and coal.

Let's think back to that apple hanging from the tree. Does it have potential energy? You know it takes energy to crack a peanut in a shell. If we place a peanut directly below that apple, and if the apple should fall, do you suppose the peanut would crack? The apple has potential energy when it hangs on the tree, but it becomes energy in motion when it falls on the peanut below.

Our bodies are able to change the food we eat to allow us to release energy and move our muscles. This is energy in motion. Some of the food you eat will become part of you. Some food will later be used by our muscles to work and to give off heat. You see, energy is sort of like a rubber ball. It may lie still, but it may also bounce around a lot if we kick or throw it. The next time your teacher or mother describes you as a bundle of energy you can tell her why!

Suggested Questions:

1. What examples can you give of stored (potential) energy?
2. Can you provide some examples of energy in motion (kinetic energy)?
3. Let's see, which of these do you think are examples of energy in motion? A boy running? An apple on a tree? An airplane in the sky? Coal in the ground?
4. Who has some other examples of energy in motion?
5. Is wind an example of stored energy or is it energy in motion?
6. Is steam an example of stored energy or is it energy in motion?

Experiments:

Part I. Make a pinwheel.*

Materials

1. A sheet of paper or transparency type plastic. (Plastic may be used under the water faucet)
2. A straight pin
3. A pencil with an eraser
4. Crayons
5. A ruler
6. Scissors
7. Penny or penny sized object

The paper or plastic that makes a pinwheel must be square. You can be sure it is a square by folding it before you cut it. Next, draw lines from one corner to the opposite corner of the paper with a pencil and a ruler.

Draw a small circle about the size of a penny in the center of the paper where the lines cross. Cut the paper on the lines but not inside the circle.

Bend each of the corners into the center of the circle. Put a straight pin through the four corners and the center of the paper. Then put the pin part way into the eraser on the end of a pencil.

Now the pinwheel should spin in the wind, or when you blow on it, or when you run with it. Different decorations on a pinwheel will make new and interesting patterns as it spins.

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*"Make and Do," Childcraft, The How and Why Library, Vol. 9, p. 14 (Chicago: Field Enterprise Educational Corporation, 1965).

Part II. Energy - The ability to do work.

Materials

1. Hot plate
2. Tea kettle
3. Previously made pinwheel

By holding the pinwheel above the steam illustrate that a constant energy source exist, and that steam can be made to do work by turning the pinwheel.

What other sources of energy will turn the pinwheel? (If necessary suggest the water running from a faucet over the blades of the pinwheel.)

Activities:

1. The students will prepare posters showing different ways energy is used.

2. The students will be divided into groups and each group will be responsible for developing a collage of different ways our bodies use energy.

3. The class will be divided into three groups. The teacher will act as recorder at the chalkboard. Each individual in a group will have a turn(s) to cite an example of energy, but no example can be used more than once. The group with the largest number wins.

4. Each student will pretend to be an animal and demonstrate how that animal has a need for energy to carry out a necessary activity. (Flying, swimming, running, jumping, capturing prey, etc.)

Note: Numbers 37 and 122 in the bibliography may be helpful.

G. Concept: *How energy can be used wisely.*

Student Learning Outcome: The student will be able to relate to a conservation ethic by demonstrating energy saving techniques.

Learning Experiences:

We have been asked to conserve on heat by turning down our thermostats to 68 degrees. You always shut off lights that are not needed! Well, maybe most of the time. You know it takes coal and oil to produce the electricity we use.

Because much of our energy has been wasted, we are now becoming short of coal and oil. Many people thought we had so much that we could use it forever and however we pleased, but that's not true. People are now beginning to understand that there is only a limited amount of coal and oil. Will you help to teach the people who still don't understand that we need to conserve our coal and oil supplies?

We have developed some bad habits because we thought we had energy to burn! But do we really have energy to burn? Of course we do use energy to help us do work like planting our crops, running needed machines, keeping our houses warm in the winter, and to cook. These are necessary uses of energy and we just can't stop doing these things.

The important thing is to learn to use our energy more carefully. Many times we could walk instead of riding in a car. Do we need snowmobiles and boats with big motors?

We have found our houses don't need to be quite so warm, and that a sweater does help us conserve the heat from our bodies. How could we also provide a sweater for our house? We can be careful about using too many lights. Playing games can be a lot more fun than watching television. Does air conditioning really have to be so cold? Do we need air conditioning? Can you help people to learn about ways to conserve energy?

Some people thought energy would last forever and they have had a difficult time learning how to live with less. Now that we know how important energy is to us, and that our coal, oil and gas will not last forever, we must help all the people understand what we can do to save energy.

Won't it be exciting to see what happens when people discover that they can?

Suggested Questions:

1. Can you give some examples of how energy is wasted?
2. What poor habits of energy use do you have and how can you correct these poor habits?
3. How can you help people understand that it is necessary to conserve energy?
4. What are you doing to conserve energy?

Activities:

1. A field trip to the sanitary landfill to see the accumulation of waste materials and the energy needed to collect and dispose of these waste materials. Upon the return to the classroom

students can form groups to discuss what types of waste materials they saw, where they originally came from and the kinds of energy needed to make products when they were new. Also, develop a list of potential uses for these waste materials.

2. Weigh and graph the amount of waste material collected each day in the classroom waste paper basket.

3. Establish a waste paper magazine and newspaper collection site for the school and the community. Contact a person from the recycling center to discuss clean and dirty paper.

4. Each student will develop a list of activities they like to do best. They will list in one column those activities that use energy from a fossil fuel and in another category the activities that do not use fossil fuel. They will then rate each category on the basis of which they like best. Discussion will then follow as to how they might reduce those activities that demand high energy use.

Note: Numbers 104 and 17A/V in the bibliography may be helpful.

Closure:

At the completion of each of the seven learning experiences, as well as at the end of the total unit the teacher should refer back to the question raised on the first page of this unit following the model structure. If this question has been answered to the satisfaction of the teacher's evaluation, then closure should be completed.

INTERMEDIATE UNIT

NUTRITIONAL ENERGY

(Length: (One Period Per Day for Two Days Up
to One Period Per day for Many Days)

A. Objectives:

1. The student will chart his or her food consumption for 5 days (longer periods of time may be used).

2. Using the provided calorie listing (Table 1) for foods the student will calculate his or her total calorie intake for 5 days (longer periods of time may be used).

3. The student will compare his or her total calorie intake with Table 2 data.

4. The student will compare his or her total calorie intake with the information in Table 3.

B. Activities:

1. Class discussion concerning the value of proper nutritional diets could be used for initiating the activity.

2. Make a bulletin board display of many different kinds of foods.

3. Class discussion concerning the energy the human body uses in comparison to the energy used by transportation vehicles.

C. Support Materials:

The quantity of food needed each day varies from individual to individual. Football players, ballet dancers, and astronauts all require high protein diets. Good nutrition - good balance in one's meals - makes for better performance in sports, better complexions, and better figures.

All activity one does requires calories. The quantity used is based on the weight of the person as well as the activity. As an example - if a student weighed 80 pounds, in thirty minutes he or she would use up the following calories doing the following activities:*

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*Information taken from pages 18 and 19 of "Mr. Peanut's Guide to Nutrition," published by Standard Brands Educational Service, P. O. Box 2695, Grand Central Station, New York, New York 10017.

resting ------------- 16 calories
reading aloud ------- 28 calories
walking (3 mph) ----- 56 calories
running ------------- 160 calories
swimming ------------ 184 calories
horseback riding ---- 104 calories
dancing (the Swim) -- 96 calories

Different foods have different calorie content. Table 1 lists the calories in a variety of foods. The calorie listing is based upon average servings of each food.

TABLE 1

CALORIES FOR SOME FOODS[*]

Meat Group	
Beef round steak, ground (lean hamburger)	200
Beef roast (lean)	200
Veal cutlet	235
Liver	180
Roast chicken	170
Scallops	90
Shrimp	110
Frankfurter (1)	125
Bacon (3 strips, fried)	145
Smoked ham	185
Lamb chop	100
Egg (1 large)	80
Chili with beans	180
Chicken soup	50
Milk Group	
Milk (1 glass)	160
Skim milk (1 glass)	80
Chocolate milk shake	420
American cheese (1 slice)	110
Chocolate ice cream	200
Bread-Cereal Group	
Cream of wheat	130
Corn flakes	95
French toast (1 slice)	185
Sweet roll	180
White bread (1 slice)	65
Rye bread (1 slice)	60
Danish pastry	140
Pancake (1)	65
Snacks	
Peanuts (20)	110
Pretzels (1 large)	60
Potato chips (10)	110
Popcorn (1 cup)	65
Sandwiches	
Hamburger	380
Chicken salad	325
Bacon, lettuce and tomato	280
Cream cheese and jelly	370
Peanut butter	330
Vegetable-Fruit Group	
Asparagus	35
Green beans	25
Beets	45
Black-eyed peas	75
Peas	55
Carrots	45
Potato	95
Spaghetti (no sauce)	110
Apple	75
Orange	70
Grapefruit (1/2)	75
Strawberries	55
Pear	95
Orange juice	85
Tomato juice	50
Watermelon	90
Mixed green salad (w/dressing)	85
Cole slaw	70
Desserts	
Flavored gelatin	80
Brownie	105
Cherry pie	390
Cookie	75
Chocolate pudding	190

[*] Information taken from pages 18 and 19 of "Mr. Peanut's Guide to Nutrition," published by Standard Brands Educational Service, P. O. Box 2695, Grand Central Station, New York, New York 10017.

Here is an example of a chart the student could fill out to record his or her food intake per day. A column is also provided on the chart for recording the calories for each food stuff.

Daily Food Intake Chart

Foods	Calories
Breakfast:	
Lunch:	
Dinner:	
Snacks:	

The correct amount of food intake per day is very important for proper health. Table 2 is a table to illustrate what the calorie intake should be for the average boy and girl for each day.

TABLE 2

CALORIE INTAKE FOR AVERAGE BOY AND GIRL FOR EACH DAY*

	Age 7 to 9 (60 lbs., 51 inches tall)	Age 10 to 12 (79 lbs., 57 inches tall)
Boys	2100 calories	2500 calories
Girls	2100 calories	2400 calories

The energy required by the human body is really quite small when compared to the energy required to operate transportation vehicles.

Table 3 data could be used to make comparisons between the calories required to operate vehicles and calories required for body functions.

TABLE 3

ENERGY IN CALORIES FOR A GALLON OF GASOLINE

Fuel	Calories per gallon
Gasoline	32,168,808

A good round number to use to calculate the energy consumed by an automobile in city driving is 10 miles per each gallon of gas. Hence, a one mile trip would require 3,216,880 calories.

References

1. "Mr. Peanut's Guide to Nutrition" by Evelyn B. Spindler. Standard Brands Incorporated, 1970. Copies of this document may be obtained by writing to: Standard Brands Educational Service, P. O. Box 2695, Grand Central Station, New York, New York 10017.
2. Section Two: A selected bibliography of books and periodicals -- 31, 38, 81, 114
3. Section Three: A selected list of audiovisual materials -- 20A/V

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*Ibid.

SECONDARY UNIT

NUCLEAR POWER PLANTS

(Length: Two to Five Class Periods)

A. Objectives:

1. The student will list and describe the functions of the fuel assembly, moderators, coolant, control rods, and shielding of a nuclear reactor.

2. The student will describe the safety features used in operable nuclear plants.

B. Activities:

1. Have the students make a scale drawing of a nuclear power plant. Encourage unique ideas from the students concerning sites and landscaping.

2. Plan for a visit to a nearby nuclear power plant. If travel is not possible then invite a guest speaker who can discuss nuclear power generation (local power company personnel can furnish needed information).

References

1. "The Four Big Fears About Nuclear Power." By Ralph E. Lapp. The New York Times Magazine. February 7, 1971.

2. Section Two: A selected bibliography of books and periodicals -- 3, 25, 27, 48, 78, 83, 86, 95, 99, 100, 109, 120

3. Section Three: A selected list of audiovisual materials -- 10A/V 13A/V, 14A/V

Additional audiovisual materials:

1. The Experimental Boiling Water Reactor. 30 min. Color. Free loan. U. S. Atomic Energy Commission. Construction and operation of the reactor, including construction features, assembly of reactor components, and operation to generate 5,000 kw of electricity.

2. Power Unlimited. 12 1/2 min. Black and White. Free loan. U. S. Atomic Energy Commission. Explains how electricity is produced by nuclear energy.

3. Dresden Nuclear Power Station. 15 min. Color. Free loan. U. S. Atomic Energy Commission.

4. Fusion Research. 22 min. Color. Free. U. S. Atomic Energy Commission. Describes the nature of thermo-nuclear research.

THE DEMAND FOR ELECTRICAL ENERGY

(Length: One to Three Class Periods)

A. Objectives:

1. The student will make a prediction of the population for the United States in the year 2020 using data from Table 1.
2. The student will make a prediction of the power consumed per person per year in the United States in the year 2020 using data from Table 2.
3. The student will make a list of the appliances which consume electricity in his or her home.
4. Using the list developed in objective number 3 the student will calculate the total annual kilowatt-hour consumption for his or her home by using Table 3.
5. Using the annual kilowatt-hour consumption calculated in objective 4 the student will calculate the annual kilowatt-hour consumption per person in his or her family.

B. Activities:

1. Small group (5-7 students) discussions concerning the role which electricity plays in supporting our current standard of living. Discussion might include necessary adaptations we would be forced to make if our energy supply was seriously cut.
2. Calculation of electrical consumption per person in each student's home by a listing of all home electrical devices and using the appropriate support materials in Part C of this activity.
3. Interpret population graphs made using data from Table 1 of Part C of this activity.
4. Interpret power consumed graphs made using data from Table 2 of Part C of this activity.

C. Support Materials:

Energy, the ability to do work, is the basic building block of civilization. The quantity of energy available for use by a given nation largely determines the standard of living of that nation. Using average data a citizen of the United States uses about 10% more energy than his or her closest counterpart which lives in Canada.

Population and power needs compiled by the electricity industry for the United States are illustrated in Tables 1 and 2.

TABLE 1

POPULATION DATA FOR THE UNITED STATES*

U. S. Population	1950	1970	1980	2000
(millions)	142	200	232	301

TABLE 2

POWER CONSUMED IN THE UNITED STATES*

Power consumed per person per year	1950	1970	1980	2000
(kilowatt-hours)	2000	7000	13,000	33,000

The modern home in the United States contains many electrical appliances. It is an interesting activity to determine the total power used in the home and then calculate the power used by each person in the family. The amount per person is found by dividing the total kilowatt hour figure by the number of persons in the family. It is also interesting to compare individual kilowatt-hour consumption values among members of the class.

Using the data in Table 3 the above exercise can be accomplished.

TABLE 3

ELECTRICAL CONSUMPTION FOR SOME COMMON HOME APPLIANCES*

Appliance	Estimated Annual KWH Consumption
Air Conditioner, Window	940
Bed blanket	147
Broiler	100
Carving knife	8
Clock	17
Clothes Dryer	993
Coffee maker	106
Deep Fat Fryer	83

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*Data for this table was taken from "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil," by John J. McDermott and others. Pennsylvania Department of Education, 1973.

Appliance	Estimated Annual KWH Consumption
Dehumidifier	377
Drill, Electric	65
Dishwasher	363
Fan, Attic	291
Fan, circulating	43
Fan, furnace	450
Fan, window	170
Floor polisher	15
Food Blender	15
Food freezer (15 cu. ft.)	1,195
Food freezer, frostless (15 cu. ft.)	1,761
Food mixer	13
Food waste disposer	30
Frying Pan	186
Grill, sandwich	33
Hair dryer	13
Heat lamp	13
Heat pump	13
Heater, radiant	176
Heating Pad	10
Hot Plate	90
Humidifier	163
Iron (hand)	144
Iron (mangle)	158
Light Bulbs	25
Oil burner or stoker	410
Radio	86
Radio-phonograph	109
Range	1,175
Refrigerator (13 cu. ft.)	728
Refrigerator (12 cu. ft. frostless)	1,217
Refrigerator-freezer (24 cu. ft., frostless)	1,828
Roaster	205
Saw	65
Sewing Machine	205
Shaver	18
Sun Lamp	16
Television (B & W)	362
Television (Color)	502
Toaster	39
Tooth brush	5
Vacuum Cleaner	46
Waffle Iron	22
Washing machine, automatic	103
Washing machine, non-automatic	76
Water Heater, standard	4,219
Water Pump	231

If you know the amperage rating of any appliance, you can estimate the kilowatt hour consumption by using the formula:

$$\text{KWH} = \frac{\text{Amps x volts}^{*} \text{ x hours of use}}{1000}$$

*Use 110 or 220 volts, whichever applies.

References

1. "A Teacher's Guide for the Environmental Impact of Electrical Power Generation: Nuclear and Fossil." By John J. McDermott and others. Pennsylvania Department of Education. 1973.
2. "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil." By John J. McDermott and others. Pennsylvania Department of Education. 1973.
3. Section Two: A selected bibliography of books and periodicals -- 15, 25, 32, 33, 45, 48, 50, 87, 127
4. Section Three: A selected list of audiovisual materials -- 8A/V, 12A/V, 14A/V, 20A/V, 28A/V, 29A/V

Additional Audiovisual Materials:

1. Atomic Power Today: Service with Safety. 28 1/2 min. Color. Free loan. U. S. Atomic Energy Commission. A 15-minute abridged version is also available.
2. Tomorrow's Power - Today. 5 1/2 min. Color. Free loan. U. S. Atomic Energy Commission.

ENERGY CONSERVATION

(Length: One to Five Days)

A. Objectives:

1. The student will list in a hierarchical fashion ten modes of energy consumption.
2. The student will be able to make a scale drawing of a mass transit system for a large city in their state.
3. The student will be able to estimate the energy savings gained from the mass transit system designed in objective number 2.

B. Activities:

1. Have small group discussions concerning the usage of energy and also how energy could be conserved by using conservation techniques.
2. Have each student design a scale drawing of a mass transit system for a large city in your state. The student should estimate the fuel savings accomplished if his or her system was used.
3. The mandatory anti-pollution devices on automobile engines have reduced gasoline mileage. Have small group discussions concerning this problem and then hold a culmination exercise for the entire class dealing with the anti-pollution - consumption problem.

C. Support Materials:

The use of energy sources have effects upon the environment. The following table summarizes these effects of electrical power generation as well as the supply for each of four sources.

ENVIRONMENTAL EFFECTS OF ELECTRICAL POWER GENERATION[*]

ENERGY SOURCE	EFFECT ON LAND	EFFECTS ON WATER	EFFECTS ON AIR	BIOLOGICAL EFFECTS	SUPPLY
Coal	Disturbed land Large amounts of solid waste	Acid mine drainage Increased water temperature	Sulfur oxides Nitrogen oxides Particulates	Respiratory problems from air pollutants	Large reserves
Oil	Wastes in the form of brine	Oil spills Increased water temperature	Nitrogen oxides Carbon monoxide Hydrocarbons	Respiratory problems from air pollutants	Limited domestic reserves
Gas		Increased water temperature	Some oxides of nitrogen		Extremely limited domestic reserves
Uranium	Disposal of radioactive waste	Increased water temperature		Non detectable in normal operation	Large reserves if breeders are developed

During the discussion activities the students might wish to address themselves to the following questions:

1. Do we wish to maintain our standard of living, or do we wish to give up some or all of the conveniences and products we now enjoy?
2. Do we wish to continue as we are, ignoring the environmental cost? If we do, are we willing to pay the ultimate price?
3. How can we produce the electricity we need at the least expenditure of our mineral resources and at the least cost to our environment?

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[*] "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil," by John J. McDermott and others. Pennsylvania Department of Education, 1973. p. 61.

4. What are the alternatives to the nuclear generation of power? Will these be sufficient for our needs?

5. Are the advantages of nuclear generation (or any other method of generation) worth the price?*

References

1. "A Teacher's Guide for the Environmental Impact of Electrical Power Generation: Nuclear and Fossil." By John J. McDermott and Others. Pennsylvania Department of Education. 1973.

2. "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil." By John J. McDermott and Others. Pennsylvania Department of Education. 1973.

3. Section Two: A selected bibliography of books and periodicals -- 21, 22, 31, 32, 43, 44, 45, 46, 47, 52, 53, 56, 59, 79, 85, 88, 93, 98, 114, 136

4. Section Three: A selected list of audiovisual materials -- 8A/V, 20A/V

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*"A Teacher's Guide for the Environmental Impact of Electrical Power Generation: Nuclear and Fossil," by John J. McDermott and others. (Harrisburg, Pennsylvania: Pennsylvania Department of Education, 1973), p. 122.

PRODUCTION OF ELECTRICAL ENERGY

(Length: One to Three Class Periods)

A. Objectives:

1. Using a heavy piece of paper, horseshoe and bar magnets, and iron filings, the student will demonstrate the magnetic lines of force.
2. Using two bar magnets, a piece of copper wire, and a sensitive ammeter the student will produce a measurable quantity of electric current.

B. Activities:

1. Plan time for the students to "mess about" with Oersted's loops and see if they can devise ways to increase the current output.
2. Conduct a field trip to a local generating power plant.
3. Invite a guest speaker from the local utility company to discuss some of their problems in electrical power generation.

References

1. Physics (PSSC). D. C. Heath and Company, Chicago, 1966.
2. Modern Physics, by Charles E. Dull and others. Holt, Rinehart and Winston, Inc., New York, 1963.
3. Section Two: A selected bibliography of books and periodicals -- 20, 33, 50, 51, 59, 82, 83
4. Section Three: A selected list of audiovisual materials -- 9A/V, 10A/V, 19A/V, 27A/V

FOSSIL FUELS

(Length: One Period to Five Periods)

A. Objectives:

1. The student will identify and discuss existing known reserves of fossil fuels.
2. The student will develop a graph to indicate the predicted availability of fossil fuels through the year 2000.
3. The student will discuss the availability of fossil fuels in Iowa.
4. The student will list a minimum of 5 different substances obtained from the distillation of coal.

B. Activities:

1. Visit a fossil fueled electrical generating facility.
2. Take a class field trip to a coal mine.
3. Perform destructive distillation of a small sample of Iowa coal.

C. Support Materials:

Many millions of years ago there were thick deposits of organic materials laid down as layers on the earth. These deposits became buried by additional deposits and surface stresses. Because of tremendous heat and pressure the organic materials became coal, oil, and gas.

These organic deposits can be used to produce energy. The process is quite simple, that is, combustion. In the combustion process carbon dioxide, water vapor, and many by-products are formed. Many of the by-products are undesirable materials such as sulfur dioxide, oxides of nitrogen, unburned hydrocarbons, and carbon monoxide.

> Most large fossil fuel-burning plants are similar in design. Fuel in the form of crushed coal, oil or gas is blown under high pressure into large boilers. Flames and hot gases resulting from the burning of the fuel pass over and around thousands of tubes filled with water. The water inside the tubes is converted to steam which collects in steam drums at the top of the boiler. The steam is then used to burn turbine generators to produce electricity.
>
> The most noteworthy developments in fossil fuel generation in recent years has been the increase in

plant size from about 700 megawatts to 1300 megawatts. These units have increased their efficiency by going to higher steam pressures and temperatures. Such plants are going to higher stacks for pollution dispersal, electrostatic precipitators for particulate control, and increased use of low sulfur fuel.

Gas

Gas is considered as the cleanest of the fossil fuels, since it is essentially methane which can be readily burned completely to carbon dioxide and water. It usually has a very low sulfur content. The burning of natural gas creates little noise, water or air pollution, with the main pollution being the oxides of nitrogen formed in the combustion chamber from the nitrogen and oxygen in air. Transmission of gas is normally through pipelines under the ground. They are reasonably safe and have little environmental impact, with the possible exception of the Alaskan pipeline, which will have to be carefully designed to prevent damage to the fragile Arctic environment.

Unfortunately, natural gas is being used up faster than new reserves are being discovered. Electric utilities will probably be among the first to suffer from the gas production deficiency. It is anticipated that by 1990 there will be none available for use as fuel for electric utilities. More and more the natural gas will have to be supplied from oil and coal gasification and from shipment from places as far away as Siberia.

Petroleum companies are starting to make long-term commitments to foreign countries for the purchase of liquefied natural gas. To be economical, this will have to be shipped in large super-sized tankers whose use will require the construction of large ports along our coasts. The proposed construction of such ports is now being attacked by environmentalists because of the environmental implications of their building and operation.

Oil

Because of the lack of economical technology for removing sulfur from coal, utilities and industries are turning to oil to meet the 1970 Clean Air Act requirements, especially in the northeastern United States. The slowdown in building nuclear power plants has added to this burden on the oil resources.

Wells in the United States (except Alaska) are currently pumping oil at capacity, and still the demand for oil cannot be met. We already import one-fourth of our oil, and the National Petroleum Council estimates that by the early 1980s we may need to bring in half of our oil supply from abroad.

Those responsible for our national security worry about becoming dependent on foreign oil sources, especially those in the oil-rich but politically volatile Middle East. What would happen if the Arab states should cut off our oil shipments?

Economists are worried about the huge increase in the balance of trade deficit if we turn to foreign supplies of oil. For example, Saudi Arabia has more crude oil reserves than the United States and Latin America combined. It is estimated that by 1980 Saudi Arabia will have the money to purchase one major United States corporation per year from dollars obtained from fuel sales.

In addition to the oil supply problem there is a problem of refinery capacity. Most United States refineries are running at maximum capacity, and no new refineries are slated for completion before 1974. There are no longer sufficient overseas refining capabilities, dock and terminal facilities or tankers to meet increased needs. Super-sized tankers and ports are needed for receiving increased oil shipments.

Competition exists for the amounts of available oil. For example, an increase in the number of cars, plus engine modifications to reduce emissions and increasing use of air conditioning and power accessories, has increased gasoline consumption and therefore reduced capacity for fuel oil production. Oil and gas are rapidly becoming too valuable to burn directly. We must begin to think in terms of conserving them as raw materials for making chemicals and foodstuffs which will be needed in the more distant future.

Onshore oil production rarely presents any significant pollution problems, although accidental pollution may sometimes occur from blowouts of wells or losses of oil in storage or transportation. Offshore operations present more problems, with oil spills and fires at the wells. Oil spills and discharges from tankers are also important problems to be solved. There is also the problem of contamination of inland waterways and harbors resulting from transfer of oil between or from vessels.

Coal

The fossil fuel use situation is the reverse of the fuel supply. Oil and gas supply three-quarters of U.S. energy needs including transportation, whereas coal, which supplies 20 per cent of the U.S. energy, represents three-quarters of the fossil fuel reserves. Coal is found in 38 states, and there are some 1.5 trillion tons of known reserves. The United States has more known coal reserves than the rest of the free world combined.

On the face of it, this substantial reserve should last for hundreds of years. But coal offers special problems. It is the worst offender of producing sulfur compounds which are harmful pollutants. This problem is discussed in Chapter 5. Its geographical distribution is not the best. Figure 16 shows that most of the eastern coal is anthracite, which has a high sulfur content, while most of the low sulfur lignite coal is located in the west, far from places where the energy is most needed. Coal is also responsible for large amounts of waste products. These are discussed in Chapter 6.

Furthermore, getting coal out of the ground without major damage to the environment has become a serious problem. Underground coal mines pollute the water table, harbor fires, and have caused millions of acres of surface land to subside, breaking roads and sewers and collapsing buildings. Underground mining is a hazardous industry in terms of mine accidents and disabling black lung disease.

Strip mining is safer, and much cheaper--it costs only about half as much to mine by stripping than by deep mine operations. Currently 44 per cent of all coal mined comes from strip mining. But strip mining destroys surface landscapes and can pollute river and water supplies with silt and acid mine drainage. It is possible, however, to prevent much of this damage through proper land reclamation, adequate drainage and planting to achieve soil stabilization. Supporters of tough anti-stripping legislation estimate that meaningful reclamation of strip mines would add about 15 cents per month to the average consumer's electric bill. Some states now have partial bans on strip mining, and others have some type of reclamation requirements, but of the more than 1.5 million acres of American land stripped for coal, two-thirds are unreclaimed, and these areas keep on producing acid drainage, erosion and esthetic blight.

Delivery of coal is often hampered by a shortage of railroad hopper cars and the problems of mines being closed by strikes.

Since transportation of coal is so expensive, some companies are building power plants atop the coal mine and sending the electricity to market by wire. For example, most Philadelphia-Baltimore-Washington consumers get electricity from a trio of huge mine-mouth plants atop Chestnut Ridge, an immense coal-bearing mountain in western Pennsylvania.*

For information and directions for the destructive distillation experiment the teacher and students should refer to the following text:

> Introductory Physical Science (IPS). Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1967, pages 4-5 and 69-75.

References

1. Introductory Physical Science (IPS). Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1967.
2. Section Two: A selected bibliography of books and periodicals -- 14, 17, 19, 23, 27, 28, 72, 95, 111, 115
3. Section Three: A selected list of audiovisual materials -- 6A/V, 22A/V, 26A/V

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*"The Environmental Impact of Electrical Power Generation: Nuclear and Fossil," by John J. McDermott and others. (Harrisburg, Pennsylvania: Pennsylvania Department of Education), pp. 29-31.

ADDITIONAL RESOURCES

ADDITIONAL RESOURCES

Energy Simulation Game

The Edison Electric Institute has copyrighted a developed simulation game entitled "The Energy-Environment Game." The game materials contain the following items:

32 -- Player's Guides
1 -- Teacher's Guide
32 -- Role Cards (2 Sets)
1 -- 18 min. filmstrip
1 -- 33 1/3 RPM Record
8 -- Sets of Prime Source References
(Classroom Library)

The game can be played with as few as 20 players and as many as 40.

The following materials were copied from the Player's Guide to help give you a feeling for the materials.

From Page 15

VI. About Role Playing

Each participant in the simulation is assigned a different role profile that describes the background and point of view of an individual person. Thirty-two different roles are provided to assure that certain attitudes will be voiced in the meetings.

- A role profile is not a script. Use it to learn about the type of person you are portraying but don't expect it to tell you everything you need to say.
- You do not need to agree with or even like the role you are assigned in order to play it. The game is so designed that there will be ample opportunity to explore all points of view.
- Don't be afraid to expand your role. Feel free to make up personal facts and specific information about where you live. Use your knowledge of human nature and make your role into a real person.
- Don't be afraid to change your opinions during the course of the simulation. You should try to win people over to your point of view, but you may find their arguments more convincing. In real life people do change according to what they learn.

- Use whatever tactics you can to get the information you need. If you can get another student to lend you material that you don't have, read it, compare it to what you do have, and see if you can use it to your benefit.

- Stay in your role during class time. If there is a break in a meeting, continue to play the person you represent. Use the time to discuss things informally.

- Use your own name but wear your Role Tag to each meeting. It will help other students identify you.

- Prepare a few sentence summary about your role that you can use to introduce yourself at the different meetings.

- Relax and enjoy yourself.

From Pages 1 and 2

I. An Overview of the Problem

As a nation and as a people, we are faced with political and social problems. They are complex and defy easy solution. Wars, racial tension, poverty--they can't be legislated away.

As an economic system, we face problems domestically and internationally of a considerable magnitude.

As a species, man is part of a global ecosystem. Some people say this ecosystem is in danger as a direct result of man's actions and decisions. Man-made pollution isn't new; it began the moment man learned how to use fire. Since that time man has improved his personal situation at the direct expense of his environment.

Energy, the ability to perform work, has been a foundation of our society's social and economic growth. It is the large scale use of energy--fossil fuel, hydroelectric, and now nuclear--which has created affluence and pollution.

There was a time not too long ago, when man thought that he had an abundance of resources. He could cut down forests, rip open land to expose coal and ore, discharge waste matter into streams--it didn't matter because there was a lot of land and relatively few people. But, we all know what happened--population growth caught us just as sure as 2 + 2 = 4. Now, we are beginning to know what it means to have finite resources. Now, we are beginning to know that social, economic, political and environmental systems are complex and interdependent. You can't change one part of the system without affecting the others.

The U. S., with some 6% of the world's population, consumes about 35% of the world's yearly electric energy production. Our demand for all forms of energy over the years has been growing at an average of 3%; but, our demand in the last five years for all forms of energy has jumped to a 4.1% annual increment. The primary markets for energy are: transportation, industrial-commercial, electric utilities, and residential. There is a very clear shift towards electricity. Right now, electricity production accounts for about 25% of the total energy used. By the year 2000 it is projected that the production of electricity will account for approximately 50% of the energy used.

The use of electric energy during the 1961-1971 period grew at the rate of about 7.1% each year--that gives a doubling period in total electric energy consumption of slightly over ten years.

We face two major problems in trying to provide the electric energy we demand: One is the limited supplies of environmentally acceptable fossil fuels (coal, gas, oil), and the other is the environmental impact resulting from the production of energy.

The electric utility industry historically has provided the electric energy demanded by the public at reasonable costs. But in order to keep pace with increasing demands for energy resulting from population growth and pushed even higher by technological and social change, new generating plants will have to be built.

Power plants are one of the sources of pollution. That is indisputable. The major question facing society is: How much energy is needed and at what environmental costs? This is not a question that the electric utility industry is obligated to answer by itself. This is a question for society. It is not a simple question--it is a continuous question. Short-term and long-term decisions involve social, political, technological, economic and environmental problems. All people should participate in working with this complex nationwide-worldwide problem.

From Page 3

II. Playing the Energy-Environment Game

For the next week or so, you and your fellow students will be participants in a simulation designed to explore the problems raised above. A simulation is a simplified model of reality in which participants assume roles of various people whose lives and/or businesses would be affected by the ways the problems are solved. During the simulation you will be discussing different points of view, doing research, making decisions and proposing plans of action.

At various points in the game you will be given or have available:

a) A Role Profile, describing the background and attitudes of one person--either an electric utility official, a representative of a conservation or environmental group, a business or professional person, or a resident. Later in this guide you will find some directions for using your Role Profile.

b) Prime Source Reference Material, giving factual support to the point of view of roles. Suggestions for using this information are included later in this guide.

c) Site Selection Information, giving specific data about the area served by the electric utility company. This will be distributed at the close of day three.

d) This Player's Guide which will give you all the information you need to get started. Simulation manuals have a way of sounding much more complicated than they really are because of the vast amount of information that must be transmitted. Don't try to remember everything at once. You will have ample opportunity to go over it again as the need arises. Most things will fall into place as you play, so relax and enjoy the experience.

From Pages 16-20

List of Roles with Typical Role Comment

This information is provided to help you identify other players.

GROUP ONE: Electric power company officials

1) Company President

"It is my responsibility to serve the public--the consumers--with the electric energy they require at reasonable rates."

2) Senior Vice President, Electric Operations

"The electric energy business is complex. I have to worry about the conversion of fuel into electric energy, its transmission, and distribution."

3) Vice President, Service and Customer Relations

"Energy is essential to our civilization. We need electric energy for our industrial and economic growth, but we need to help our customers use electricity wisely."

4) Director, System Planning

"You have to think and plan ahead to meet demand. Population growth, technology, social change--they all put pressure on the demand for electricity."

5) Director, Environmental Activities

"Sure, there are abuses to our environment; but you have to balance costs and benefits. We are doing our best with technology to offer the needed electricity, cut down on environmental effects and help clean up the environment."

6) Director, Research and Development

"There are new techniques available, and I am confident that further breakthroughs will occur in electric generation which will reduce the amount of pollution caused by electric power plants."

7) Supervisor, Engineering Construction

"I've been around a lot of jobs in my twenty-three years in construction, but these new plants are fantastic."

8) Plant Manager

"I feel responsible to the public to generate electricity for them. I'm proud of my work. My son just joined the company, too."

GROUP TWO: Conservation and Environment

9) Executive Director, Natural World Society

"The crisis facing the world today is our gluttony. We have to go on a diet--an energy diet."

10) Regional Director, Universe Club

"There is a limit to growth. Man has got to begin to plan for a reasonable world."

11) Regional Representative, Scientists for Safety

"Science allows man to do many amazing things; but there is a lot we just don't know about. We must be careful making decisions that could affect not only local population but civilization as a whole. Nuclear energy is needed, but caution is necessary."

12) Regional Director, Conservation League

"Pretty soon there won't be much of a world left, we are using it up too fast. Man has got to wake up to what he is doing."

13) Steering Committee Member, State Conservation League

"Short term, I think we have to go ahead to provide the electric energy demanded; but long term, we just have to tighten our belts."

14) Steering Committee Member, Local Conservation League

"So I'm an old lady, I think what I have to say is important. Our world has lost its sense of values. It's most obvious in the way we have treated our environment. There is still time for change."

15) President, Student Quality of Life Group

"Youth must be heard; it's our environment too."

16) Advisor to Student Quality of Life Group

"I believe in causes, but I believe that moderation is essential if you want to advance your cause. Wild shouting might be satisfying, but it rarely accomplishes much."

GROUP THREE: Commerce, Industry and Professions

17) President, Large Manufacturing Firm

"Industry is essential to our society for jobs and for progress. Energy is the foundation of industry, and electricity is the most convenient form of energy for my business."

18) Owner, Electronic Components Firm

"Without electric energy, I'm out of business in more ways than one; no way to manufacture my products and no demand for them."

19) Accountant

"You have to look at the trade-offs in everything. There are costs and there are benefits. Society has to decide what they want and how much they are willing to pay. Maybe we are paying too much in terms of our environment."

20) TV Station Manager

"Technology has become a monster; it has gotten out of hand. People need to wake up and look around before it's too late. We may have given the electric utility industry too much freedom in the past."

21) Hospital Administrator

"Essential services run on the use of energy--mostly electric energy."

22) Architect and City Planner

"We need to rethink our cities and our way of life."

23) Executive Director, Chamber of Commerce

"We should all calm down and look at the facts in their proper place. This area needs to grow, but we must plan our growth."

24) Newspaper Reporter

"All you have to do is take a quick look at our civilization to see that energy is what makes us tick. You can't just shut off our civilization."

GROUP FOUR: Residents

25) Construction Worker

"No electricity, no jobs; no jobs, no money."

26) Housewife

"I agree with my children that the environment is more important than profits."

27) Lawyer

"Well, we certainly need electric energy just to keep pace with population and change; but we must be careful about tipping the environmental balance. I'll have to look into this matter more carefully."

28) Economics Instructor, Community College

"Without more electric energy unemployment would skyrocket causing vast damage to our economy and our society. It is irresponsible to talk about not having energy for growth."

29) Postman

"I believe that the old way was better -- craftsmanship and pride in your work. Doing things by hand was slower but living had more meaning in the old days."

30) Labor Leader

"Industry provides a good life for many, many people. Electricity is absolutely essential for the "good life" and that means jobs. More jobs for my people, a shorter work week, and leisure time."

31) High School Student

"I can't get too excited about the environment. It's all a big fad."

32) College Student

"We have to get back to the earth and live in harmony with people and the world."

The Energy-Environment Game can be purchased from:

Dr. Richard B. Scheetz
Coordinator, Educational Services
Edison Electric Institute
90 Park Avenue
New York, New York 10016.

The cost is $20.00 for a school district. If your local power company is an affiliate of Edison Electric Institute they should have the game available for loan to your school.

IOWA GEOLOGICAL SURVEY MATERIALS

The following section has been reprinted with permission from the Iowa Geological Survey Office, Iowa City, Iowa. Some of the information as indicated has been taken from unpublished data that has not been completely verified. It is the best information they have available to date, however.

Iowa Energy Demand

Total Iowa energy consumption in 1972 was 844 trillion Btu. With 1.4% of total U. S. population, Iowa consumes about 1.2% of the total energy used in the U. S. Per capita energy consumption in the state is equal to about 298.7 million Btu, or 54.3 barrels of fuel oil equivalent per capita. Fuel consumption per capita can be further split into individual fuel types.

Iowa per Capita use of Individual Fuels

Energy	295.9	million Btu
Coal	2.38	tons
Natural Gas	122,721	cubic feet
LPG	139.6	gallons
Gasoline	617.8	gallons
Fuel Oil	224.1	gallons
Kerosene	5.5	gallons
Residual Oil	4.3	gallons
Hydroelectric	319.4	killowatt-hours

Source: Iowa Geological Survey, unpublished data.

Iowa imports almost all the energy it consumes. The state has a proven coal reserve of 6.5 billion tons and an estimated hypothetical reserve of 21 billion tons.

In 1972, 851,000 tons of coal were mined in Iowa. Of the total coal used in the state only 10.7 percent, or 730,000 tons, was domestic in origin. Iowa coal has a relatively high sulfur content of 4 to 10%, and emits large amounts of fly ash and particulate matter when combusted. The large amounts of ash contained in Iowa coal lower the energy content of the fuel to 8,500 Btu per pound, instead of the 12,000 Btu per pound of its native quality. Because of these disadvantages and some difficulties in mining Iowa coal, it has been more profitable in the past to import Illinois coal. Recently large amounts of low sulfur coal have been imported into the state from Wyoming due to higher air quality standards.

Iowa's energy consumption is similar to that of the rest of the country, although the state is more dependent upon natural gas than are other areas. Iowa's total energy is supplied by 42.1% natural gas as contrasted with 33.3% for the total U. S.

Iowa Energy Consumption

Fuel	Amount (trillion Btu)	Percent of Total
Coal	142	16.7
Natural Gas	355	41.8
LPG	37	4.3
Gasoline	215	25.3
Distillates	87	10.2
Imported Electric Energy	11	1.3
Hydroelectric	3	.4
	850	100%

Source: U. S. Department of the Interior, Energy Fact Sheets, 1973.

Iowa's fuel use can be separated into the same market sectors as U. S. energy demand. Some additional divisions can also be made. Agriculture, a vital part of the state's economy, uses petroleum products in the production of crops and livestock. Iowa's elementary and secondary schools use petroleum products for the transport of pupils and for space heating of facilities. The state's hospitals are also major users of fuel.

Iowa Energy Consumption, by Consumer Sector

Sector	Trillion Btu	Percent of Total
Residential and Commercial	204.6	23.9
Industrial	143.4	16.8
Transportation	226.0	26.6
Electric Generation	195.65	22.9
Schools	10.22	1.2
Hospitals	2.62	.31
Agriculture	34.6	4.1
Miscellaneous	36.0	4.2
	850.3	100%

Source: Iowa Geological Survey unpublished data

Residential and Commercial Sectors

The residential and commercial sectors use fuels for house heating, water heating, and cooking. Iowa is more reliant on natural gas for house heating than the rest of the U. S. Natural gas supplies heat 62.8% of the occupied housing units in the state, as compared with 55.2% of the housing units in the country. A large percentage of rural residential consumers, 27.8%, use LPG gas as a house heating fuel.

House Heating Fuels in the State of Iowa, 1970

Fuel	Urban	Rural	Total	Percent of Total
Utility Gas	457,875	105,141	563,016	62.8%
Fuel Oil	44,406	141,673	186,079	20.8
Coal or Coke	3,504	9,573	13,077	1.5
Wood	92	1,313	1,405	.2
Electricity	6,719	10,279	16,998	1.8
LPG	8,862	103,440	112,302	12.5
Other Fuel	2,598	768	3,366	.3
None	---	68	68	.1
	524,056	372,255	896,311	100.0

Source: U. S. Bureau of Census, 1970 Census of Housing, 1972.

Commercial consumers have similar fuel needs as residential customers. Therefore, the two categories are usually considered together. The hospitals and elementary and secondary schools in the state can be separated from the rest of commercial sector.

Fuel Use by Residential and Commercial Consumers in the State of Iowa, 1972

Fuel	Amount	Trillion Btu	Percent of Total
Coal	0.10×10^6 tons	1.91	.94
Natural Gas			
a) residential	89.20×10^9 cf	92.00	45.30
b) commercial	50.80×10^9 cf	52.40	25.80
LPG	221.50×10^6 gal	20.99	10.30
Distillates	235.78×10^6 gal	32.72	16.10
Residual	7.50×10^6 gal	1.00	.50
Kerosene	15.60×10^6 gal	2.00	1.00
		203.02	100.00

Source: Iowa Geological Survey, unpublished data, 1973.

Hospital Sector

There are about 140 hospitals in Iowa. Their total fuel use amounts to only about .3 percent of Iowa's total energy consumption. Although hospital use of fuels is small, it cannot be reduced through conservation measures. Large amounts of space heating fuels are needed to maintain constant temperatures in hospital facilities. Additional fuels are needed to operate equipment such as incubators, electrocardiograms, etc. The majority of the hospitals in the state are dependent on natural gas for space heating. Most of the state's hospitals are interruptible natural gas consumers. They pay a lower rate and their service can be interrupted whenever demand for natural gas exceeds the available supply. Firm natural gas customers pay a higher rate and their service cannot be interrupted. When natural gas is not available to interruptible customers, most hospitals consume number two fuel oil. Coal is used by the University of Iowa hospitals complex.

Hospital Fuel use in Iowa, 1972

Fuel	Amount	10^{12} Btu	Percent of Total
Natural Gas	1.95×10^9 cf	2.01	76.7
Fuel Oil #2	4320×10^3 gal	.6	22.9
Fuel Oil #5	2.25×10^3 gal	.0003	.01
LPG	342×10^3 gal	.003	.11
Coal	1350 ton	.003	.11
		2.62	100%

Source: Iowa Hospital Association, testimony before the Iowa Commerce Commission, October 30, 1973.

School Sector

There are about 712,000 elementary and secondary students enrolled in public and private schools in the State of Iowa. The majority of the school buildings in the state use natural gas for space heating purposes. About half as much fuel oil is consumed as a primary fuel and also as an alternate space heating fuel when natural gas cannot be obtained.

Large quantities of gasoline are used for daily and extracurricular transport of students. Almost all of the gasoline is used for the daily transport of students. Only 11% of total gasoline consumed by the school sector is used for extracurricular transportation. About 3.5% of total gasoline use is consumed for maintenance purposes.

Elementary and Secondary Schools, Public and Non-Public
Fuel use in Iowa, 1972

Fuel	Amount	Btu (10^{12})	Percent of Total
Fuel Oil	19.4×10^6 gal	2.68	26.2
Natural Gas	5.26×10^9 cf	5.42	53.0
Coal	3.6×10^3 ton	.09	.88
LPG	$.15 \times 10^6$ gal	.001	.01
Gasoline(total)	16.3×10^6 gal	2.03	19.9
daily transportation	14.4×10^6 gal	1.8	---
extracurricular transportation	1.3×10^6 gal	.16	---
maintenance	$.57 \times 10^6$ gal	.07	---
		10.22	100%

Source: Iowa Geological Survey, unpublished data.

Agriculture Sector

There are 140,354 farms in Iowa. Energy is used by agricultural consumers in all facets of farm operations. Detailed statistics of fuels used in agriculture are not kept, but it is possible to make determinations based upon crop and livestock statistics and amounts of fuel used in raising farm products.

Large amounts of propane are used by farmers in grain drying. Field-shelled corn is usually in the range of 24 to 25% moisture when harvested. For safe storage, field-shelled corn should be dried down to 13 to 14% moisture content. On an average, then, to reduce the moisture content of a bushel of corn from 24.5% to 13.5% will require removal of 8.35 pounds of water. It is estimated that 0.3 gallons of propane are required to remove one pound of water from a bushel of corn. On this basis, then, about 0.25 gallons of LPG will be needed to dry one bushel of corn. As corn is frequently not dried down to the optimal level of 13-14% moisture, it is usually estimated that anywhere from .15 to .25 gallons of LPG will be required to dry one bushel of corn. In 1972, Iowa's corn crop totaled 1.2 billion bushels. It has been estimated that 37 to 40.7% of the total crop was dried naturally, 49.8% was dried on the farm, and 9.5 to 13.2% was dried off the farm in grain elevators. From this data, it can be concluded that 105 million gallons of propane were used by farmers in grain drying. This is equal to almost a third of the LPG consumed in the state.

A certain amount of gasoline and diesel fuel is used in the raising of livestock and crops. The following figures, combined with the total number of each type of animal or crop in the state, give an estimate of total gasoline and diesel consumption in Iowa.

Estimates of Gasoline Consumed for Crop and
Livestock Production Operations under
Typical Iowa Conditions

Crop Production	Gallons/acre
Corn	7.7
Soybeans	9.0
Small grains	5.4

Livestock Production (includes all fuel used to remove feed from storage, process, and deliver to feeders)

Animal	Feeding Period	Gallons/Animals or 100 birds
Swine	Raise 1 pig to market	0.40
Dairy	Cow milking/yr	1.17
Beef	Steers-grown from 400-1, 200 lbs.	1.80
	Heavy steers-grown from 700-1, 200 lbs.	1.00
Sheep	Lambs-from birth to market	0.60
Poultry (100 birds)	Raise 100 broilers from birth to market	0.75
	Layers for one year--100 birds	7.5

Source: Iowa Department of Revenue, Estimates of Gasoline Burned for Crop and Livestock Production Operations under Typical Iowa Conditions, 1972.

Although agricultural use of fuel is only a small part, 4.1% of Iowa's total energy use, it is vital to the state's economy.

Agricultural uses of Fuel in Iowa, 1972

Fuel	Amount	Btu	Percent of Total
LPG (for grain drying)	116.8×10^6 gal	11	31.4
Diesel	77.8×10^6 gal	11	31.4
Gasoline	76.6×10^6 gal	13	37.1
		35	100%

Electric Generation Sector

Five investor owned utilities, 82 municipal electric utilities, and over 150 rural electric cooperatives produce and distribute electricity in Iowa. The large investor owned utilities produce 92.7% of the total electricity distributed in the state.

The electric generation sector uses 77.5% of the total coal used in the state, and also uses large amounts of fuel oil and natural gas. Very little natural gas is used by electric utilities in winter months. In the past, large amounts of fuel oil were substituted for natural gas and coal.

The electric generation sector operates at about a 25% efficiency rate. Only about a fourth of the primary fuel used to generate electricity is returned to the residential, commercial, and industrial sectors in the form of electricity. About 23% of the total energy used in Iowa is consumed by the electric generating sector.

Electric Generation Fuel use in Iowa, 1972

Fuel	Amount	Btu	Percent of Total
Coal	107×10^6 tons	17	55.7
Natural Gas	75.9×10^9 cf	72	37.5
LPG (peak shaving)	3.1×10^6 gal	1	.5
Distillate	16.2×10^6 gal	2	1.0
Residual	4.8×10^6 gal	1	.5
Hydropower	911×10^6 Kwh	9	4.7
		192	100%

Source: Iowa Geological Survey, unpublished data, 1973.

An additional 11 trillion Btu's of electricity is imported from adjoining states and distributed as electric energy within Iowa. The fuels used in the production of electricity outside the state are: Coal, 0.1 trillion Btu or six thousand tons, 4.2 trillion Btu of fuel oil or 30.8 million gallons and 6.12 billion cubic feet or 6.3 trillion Btu of natural gas. Some of the hydroelectric energy used in electric generation is also imported.

Transportation Sector

Highway uses of gasoline and diesel amount to 25% of the total energy used in Iowa. Almost all the gasoline and diesel consumed by the state is consumed by transportation vehicles. This is equal to 60% of the total petroleum products used in the state.

Interstate truck traffic accounts for almost 48% or 87 million gallons of the total diesel fuel used in the state. Six million gallons of aviation fuel are consumed by aircraft in the state.

Transportation Fuel use in Iowa, 1972

Fuel	Amount	Btu	Percent of Total
Gasoline (motor and aviation)	1,516.3 x 10^6 gal	203	89
Diesel	167.4 x 10^6 gal	23	11
		226	

Source: Iowa Geological Survey, unpublished data, 1973.

Industrial Sector

Only about 17% of Iowa's total energy is used in the industrial sector. This is a low figure that does not take into account large amounts of propane ethane and other petroleum products that are used in raw material, or finished products. One company alone in Iowa uses almost as much LPG as the entire residential and commercial sectors. Over two-thirds of the total fuel used in the industrial sector is natural gas. Natural gas use in the industrial sector is evenly split between interruptible and firm service. Almost all coal that is not used for electric generation is used as an alternate fuel by industrial consumers.

Due to the fact that the use of petroleum products as feedstock cannot be accounted for, an accurate picture of industrial fuel use cannot be derived at this time. The consumption figures below include space heating, process heat, and direct heat uses of fuel by industries in the state.

Industrial Fuel use in Iowa, 1972

Fuel	Amount	Btu	Percent of Total
Coal	1.3×10^6 ton	35	24.4
Natural Gas	101.1×10^9 cf	104.2	72.7
LPG	29.4×10^6 gal	2.61	1.8
Distillates	8.9×10^6 gal	1.2	.8
Residual	2.4×10^6 gal	.36	.25
		143.4	100%

Source: Iowa Geological Survey, unpublished data, 1973.

Miscellaneous Fuel Uses

Energy consumption that cannot be accounted for by any of the above sectors accounts for four percent of the total energy used in the state. These miscellaneous users of fuel include the military, oil companies, fuel for pipelines, and fuels used for vessel bunkering.

Miscellaneous uses of Fuel in Iowa, 1972

Fuel	Amount	Btu	Percent of Total
Anthracite			
Natural Gas	24.0×10^9 cf	22.2	61.5
LPG	17.8×10^6 gal	2.0	5.6
Distillate	71.9×10^6 gal	9.85	27.3
Residual	1.9×10^6 gal	.3	.8
Kerosene	4.8×10^6 gal	.66	1.8
		36.01	100%

Source: Iowa Geological Survey, unpublished data, 1973

ENVIRONMENTAL RELATED ORGANIZATIONS AND ADDRESSES

I. PRIVATE ORGANIZATIONS

1. National Intervenors
   153 E Street, S.E.
   Washington, D. C. 20003

2. Sierra Club
   1050 Miles Tower
   San Francisco, California 94104

3. Scientists Institute for Public Information
   30 East 68th Street
   New York, New York 10021

II. GOVERNMENT AGENCIES

1. United States Environmental Protection Agency
   Washington, D. C. 20202

2. United States Atomic Energy Commission
   Washington, D. C. 20202

3. Superintendent of Documents
   (Ask for the Governmental Publication List)
   Washington, D. C. 20202

III. OTHER ORGANIZATIONS

Foundation for Alternative Energy
407 North Maple Drive
Beverly Hills, California 90210

This organization produces wall charts, pamphlets, and other materials relating to the energy and environmental problems.

A very well done wall chart entitled "Energy Options for Man" may be purchased by sending a stamped (32¢ for First Class), self-addressed, 9" x 12" envelope and 25¢ for handling and printing costs.

PUBLIC INTEREST REPORT--
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GLOSSARY OF TERMS

The following terms have been included to aid you in your investigating the energy problem. The terms have been excerpted from the three sources listed at the conclusion of the glossary.

Atom

A particle of matter whose nucleus is indivisible by chemical means. It is the fundamental building block of the chemical elements.*

Atomic Energy Commission

(Abbreviation AEC) The independent civilian agency of the federal government with statutory responsibility for atomic energy matters. Also the body of five persons, appointed by the President, to direct the agency.*

Atomic Number

(Symbol Z) The number of protons in the nucleus of an atom, and also its positive charge. Each chemical has its characteristic atomic number, and the numbers of the known elements form a complete series from 1 (hydrogen) to 105.*

Atomic Weight

The mass of an atom relative to other atoms. The present-day basis of the scale of atomic weights is carbon; the most common isotope of this element has arbitrarily been assigned an atomic weight of 12. The unit of the scale is one-twelfth the weight of the carbon-12 atom, or roughly the mass of one proton or one neutron. The atomic weight of any element is approximately equal to the total number of protons and neutrons in its nucleus.*

Breeder Reactor

A reactor that produces more fissionable fuel than it consumes. The new fissionable material is created by capture in fertile materials of neutrons from fission. The process by which this occurs is known as breeding.*

British Thermal Unit (BTU)

The standard unit for measurement of the amount of heat energy, such as the heat content of fuel. Equal to the amount of heat energy necessary to raise the temperature of one pound of water one degree Fahrenheit.**

Calorie

Unit of quantity of heat. The amount of heat required to raise the temperature of 1 gram of water through 1 degree Centigrade.***

Demand

The rate at which electric energy is delivered to or by a system at a given instant or averaged over any designated period of time, expressed in kilowatts or other suitable units.**

Ecology

The science dealing with the relationship of all living things with each other and with their environment.*

Ecosystem

A complex of the community of living things and the environment forming a functioning whole in nature.*

Electrical Energy

The energy associated with electric charges and their movements. Measured in watt hours or kilowatt hours. One watt-hour equals 860 calories.***

Energy

Capacity for doing work. Forms: potential, kinetic, electrical, heat, chemical, nuclear and radiant.***

Fast Breeder Reactor

A reactor that operates with fast neutrons and produces more fissionable material than it consumes.*

Fission

The splitting of a heavy nucleus into two approximately equal parts (which are nuclei of lighter elements), accompanied by the release of a relatively large amount of energy and generally one or more neutrons. Fission can occur spontaneously, but usually is caused by nuclear absorption of gamma rays, neutrons, or other particles.*

Fossil Fuels

Coal, oil, natural gas, and other fuels originating from fossilized geologic deposits and depending on oxidation for release of energy.**

Fuel

A substance used to produce heat energy, chemical energy by combustion or nuclear energy by nuclear fission.***

Fusion

The formation of a heavier nucleus from two lighter ones (such as hydrogen isotopes), with the attendant release of energy.*

Half Life

The time in which half the atoms of a particular radioactive substance disintegrate to another nuclear form. Measured half lives vary from millionths of a second to billions of years. Also called physical half life.*

Heat

Energy possessed by a substance in the form of kinetic energy, usually measured in calories--in space heating by the British Thermal Unit. Heat is transmitted by conduction, convection or radiation.***

Kilowatt (kw)

The electrical unit of power which equals 1,000 watts or 1.341 horsepower.**

Kilowatt-Hour (kwh)

The basic unit of electrical energy. It equals one kilowatt of power applied for one hour.*

Kinetic Energy

Energy due to motion.

Matter

The substance of which a physical object is composed. All materials in the universe have the same inner nature, that is, they are composed of atoms, arranged in different (and often complex) ways; the specific atoms and the specific arrangements identify the various materials.*

Nuclear Energy

Atomic energy, released during a nuclear reaction.***

Nuclear Power

Electric power produced from a power plant obtaining energy from nuclear reaction.***

Organic

Materials that once were living or are presently living. Compounds containing the element carbon.

Petroleum

Mineral oil. Fractional distillation yields gasoline, diesel, lubricating oil and other products.***

Photosynthesis

The process by which plants make food and oxygen in the presence of light.

Potential Energy

Energy due to position or condition; stored energy.

Power

The rate of doing work, measured in watts or horsepower.***

Propane

Inflammable gas obtained from petroleum.***

Radioactive

Exhibiting radioactivity or pertaining to radioactivity.*

Radioactivity

The spontaneous decay or disintegration of an unstable atomic nucleus, usually accompanied by the emission of ionizing radiation. (Often shortened to activity.)*

Sedimentary Rock

Rock formed from the sediments in bodies of water.

Thermal Plant

A power generating plant which uses heat to produce energy. Such plants may burn fossil fuels or use nuclear energy to produce the necessary thermal energy.**

Watt

The unit of measure for electric power. Wattage of electric power operated equipment or devices is determined by multiplying required volts by required amperes (volts x amps).***

Watt Hour

Work done at the rate of 1 watt for 1 hour.***

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*These terms were taken from the Glossary of Terms of the publication, "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil," by John J. McDermott and others, Pennsylvania Department of Education, 1973.

**These terms were taken from the Glossary of the publication, "Energy and Man's Environment," by Thomas F. Ris and others, Oregon State Department of Education, 1973.

***These terms were taken from the Glossary of Terms of the publication, "Energy Crisis," by Wendell Curry and others, Oregon Board of Education, 1973.